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BROADBAND REFERENCE GUIDE

Rev 8.0

BLONDER TONGUE LABORATORIES, INC.

BROADBAND REFERENCE GUIDE

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LABORATORIES, INC.

Thank you for requesting our Broadband Reference Guide. We hope you find this latest update helpful as we strive to provide technical information for the broadband industry in a convenient pocket size book.

Remember to look for previous versions of the reference guide on the Blonder Tongue website. We welcome any suggestion for further improvement, simply e-mail: feedback@blondertongue.com.

Bob Pallé
President

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Company Profile

Have you looked at us lately?

Founded in 1950, Blonder Tongue Laboratories, Inc. has been an innovative designer and manufacturer of products for the cable television industry. Initially, the focus was to develop technology for niche cable television applications, and this focus gave the Company a dominant position in the private cable market. The Company has evolved from a manufacturer of electronic equipment for the private cable market to a principal provider of integrated network solutions and technical services to broadband service providers in several related markets. The Company designs, manufactures, and supplies a comprehensive line of equipment to deliver video (Analog, Standard Digital, and High Definition Digital), high speed data and voice services over existing integrated coaxial and fiber optic broadband networks and maintains ongoing research and development efforts to enable the delivery of such services over packet based, Internet Protocol networks of the future.

The Company serves both the franchised and private cable markets and is a provider of integrated network solutions to all of the related video markets, including the multi-dwelling unit "MDU" market, the lodging/hospitality market and the institutional market consisting of hospitals, prisons and schools.

Our philosophy is to offer the highest quality in both product and services. The Blonder Tongue Technical Solutions Group, supported by our Engineers and Product Managers, can handle your most challenging questions and provide expert product information, site surveys, installation, on-site system engineering, turn-key system construction, system design or complete test and measurement of any installed system.

From our MASTERBUILT pre-built headends, to the latest in Digital and High Definition technology – we have the products, and your solution!

For more information about Blonder Tongue, visit our website at: www.blondertongue.com

Headend Products

A specification summary is provided in this section to aid in installing and setting up common headend equipment. For more detailed information, please see Blonder Tongue's full line catalog, website or the instruction manual(s) provided with the individual headend equipment. Blonder Tongue provides a full line of headend equipment such as:

- 8VSB/QAM Demodulators
- Digital to Analog Processors
- QPSK/QAM Transcoders
- Integrated Receiver/ Descramblers
- Commercial Satellite Receivers
- Commercial Digital Satellite Receivers
- Agile Audio/Video Modulators
- Channelized Audio/Video Modulators
- Channelized Agile Audio/Video Modulators
- Modular Headend Systems
- Agile Heterodyne Processors
- Agile Audio/Video Demodulators
- Stereo Encoders
- Combiners
- 8VSB Heterodyne Processors
- QAM Modulators
- Channel Elimination Filters
- Headend Racks & Housings
- Low Cost Headend Products
- Complete Headend Fabrication Services

Headend Product Overview - Comparison Tables

Modulators

Analog	Maximum Frequency MHz	Broadband Noise	Type	IF Loops	Output Level
AM-60-860	860	76	Agile	Single	+60 dBmV
AM-45-550	550	76	Agile	Single	+45 dBmV
AM-60-550	550	76	Agile	Single	+60 dBmV
AM-60-806	806	76	Agile	Single	+60 dBmV
FAxM-860	860	70	Agile	No	+50 dBmV
AMCM-860	860	78	Agile	No	+45 dBmV
AMM-806	806	75	Agile	No	+45 dBmV
MICM-45C/S	860	95	Channelized	No	+45 dBmV
CAMS-60	860	110	Channelized Agile	Single	+60 dBmV
MAVM-40	860	95	Channelized Agile	Single	+40 dBmV
MAVM-60	860	110	Channelized Agile	Single	+60 dBmV
BAVM-860SAW	860	90	Channelized	No	+55 dBmV

Digital					
AQM	860	75	Agile	No	+40 dBmV
DQX	860	75	Agile	No	+40 dBmV

Processors

Analog	Maximum Frequency MHz Input	Output	Broadband Noise	Type	IF Loops	Output Level
AP-60-550B	806	550	76	Agile	Single	+60 dBmV
AP-60-750B	806	750	76	Agile	Single	+60 dBmV
AP-40-550B	806	550	76	Agile	Single	+40 dBmV
AP-40-750B	806	750	76	Agile	Single	+40 dBmV

Digital	Input	Output				
DHDP	806	806 (8VSB)	76	Agile	No	+45 dBmV
DAP	860	860 (Analog)	77	Agile	Single	+60 dBmV
AQT	860	860 (QAM)	75	Agile	No	+40 dBmV

Demodulators

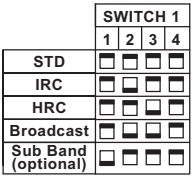
	Maximum Frequency MHz	Type	IF Loops	Output Level
AD-1 Analog	806	Agile	No	A/V
AQD Digital	860	Agile	No	A/V

Switch Settings - AP/AD-1

Blonder Tongue has improved the simplicity of the channel tuning switch settings for the following products:

Stock No.	Model	Stock No.	Model
59802	AP-40-550B	59803	AP-40-750B
59817	AP-60-550B	59818	AP-60-750B
5932	AD-1B		

2 banks of switches are presented. Switch 1 has 4 positions and Switch 2 has 8 positions. Position 1, 2 & 3 of Switch 1 are used to set the unit operating mode and position 4 turns the FCC Offsets ON or OFF.



Switch 2 is used to set the unit output channel number.

Channel setting is accomplished by setting the switch to the desired output channel.

Switch 2 is divided into 2 sections, the Tens section and the Ones section.

In each section, there are 4 switches labeled 8,4,2,1. This corresponds to the switch value.

To set the switch, a user invokes the corresponding value of the switch.

The values are then added and equated into a channel number by the unit microprocessor.

A simple chart, shown on the next page, gives the corresponding switch position for numbers 1 to 12.

The user then sets the Tens section and the Ones section together to reflect the desired channel.

Example: For CH 116, you set 11 Tens and 6 ones for 116. For single digit channels, the Tens switch is set to zero.

Switch Settings

Below are examples of the switch settings.

	SWITCH 2								
	Tens				Ones				
	8	4	2	1	8	4	2	1	
0 =	▁	▁	▁	▁	▁	▁	▁	▁	= 0
1 =	▁	▁	▁	▔	▁	▁	▁	▔	= 1
2 =	▁	▁	▔	▁	▁	▁	▔	▁	= 2
3 =	▁	▁	▔	▔	▁	▁	▔	▔	= 3
4 =	▁	▔	▁	▁	▁	▔	▁	▁	= 4
5 =	▁	▔	▁	▔	▁	▔	▁	▔	= 5
6 =	▁	▔	▔	▁	▁	▔	▔	▁	= 6
7 =	▁	▔	▔	▔	▁	▔	▔	▔	= 7
8 =	▔	▁	▁	▁	▔	▁	▁	▁	= 8
9 =	▔	▁	▁	▔	▔	▁	▁	▔	= 9
10 =	▔	▁	▔	▁					
11 =	▔	▁	▔	▔					
12 =	▔	▔	▁	▁					

SWITCH 2							
8	4	2	1	8	4	2	1
Tens				Ones			
#00-12				#0-9			

Examples:

= CH 2

= CH 58

= CH 87

= CH 116

For previous AP/AD-1 model switch settings, see the Reference Card with the unit or please visit our website: www.blondertongue.com/switchsettings

AQD - ATSC/QAM Demodulator

The Blonder Tongue ATSC/QAM Demodulator is a modular unit that allows the reception and demodulation from a modulated 8VSB or QAM signal input to a baseband NTSC video & audio output. The unit is designed to lock to an off-air 8VSB or QAM annex B digital signal and provide a NTSC video and audio output to permit the easy interface with any equipment which accepts baseband video & audio inputs such as TV displays or existing Blonder Tongue analog modulators.

Features

- 8VSB, QAM 64 & QAM 256 (Annex B) Modulated RF Input Transport Streams Supported
- Modular & Compact Units Permit High Density — 8 Modules in 3 Rack Height
- Easy Set-up & Configuration via Front Panel LCD Controls
- Remote Computer Control Capability via Internet or RS-232 Interface
- Demodulates any of the 18 ATSC Video Formats
- Left & Right Stereo Audio Output
- NTSC Video Output

Unit Front Panel

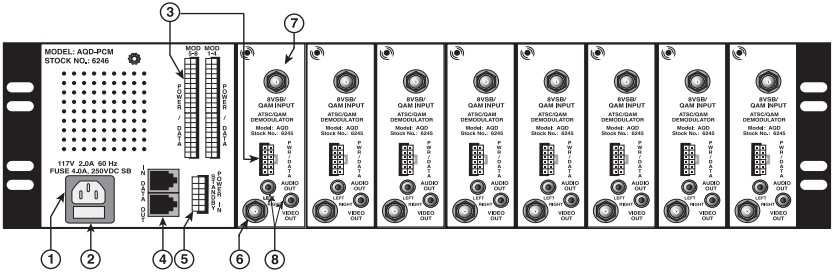
1. **Unit Status Indicator -** Provides feedback to user based on the following LED conditions:
   Solid Green ON - Indicates valid lock to the RF input signal
   Flashing Green LED - Indicates Not Locked or Scanning in process

2. **Backlit LCD -** 16 character, 2 line Liquid Crystal Display screen used to interact with user to display unit information

3. **Push Button Navigation Controls -** Buttons used to navigate between menus and operate the units

4. **9-Pin RS-232 Connector -** Used for Future AQD Module upgrade only

Unit Rear Panel



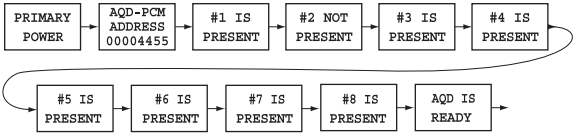
1. **Power Cord Socket** - The unit power cord plug socket
2. **Fuse Holder** - 4.0 Amp., 250V DC, Slo Blo fuse
3. **Module Power/Data Cable Sockets** - 2 cable sets with a 12-pin male connector used to deliver power and data to each AQD unit
4. **RS232 Serial Data Ports** - Used to plug into and daisy chain AQD units for remote monitoring and configuration
5. **Power IN** - 12-pin female connector used to plug-in the optional Standby Power unit
6. **Video OUT** - NTSC Composite Video output via F Connector
7. **8VSB/QAM INPUT** - RF Connector for feeding appropriate 8VSB off-air or QAM modulated RF input signal
8. **Left/Right Audio OUT** - RCA Connectors for Left/Right Audio Output

AQD - ATSC/QAM Demodulator

Operating Interface Instructions

Boot-Up Display Sequence

When the unit is first plugged in for use, the PCM displays the appropriate module condition on the LCD readout as depicted below.



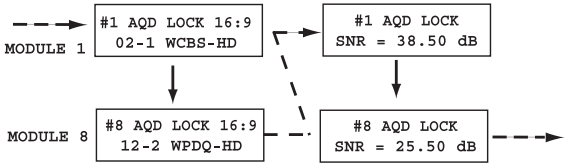
Boot-Up Display Sequence

1. Each control module has a unique module address that is set at the factory which is displayed immediately following the primary or secondary power source status. This address is used for remote software capability only.
2. Each module status is identified and reported on the LCD. If a module is identified it is listed as PRESENT or NOT PRESENT if not connected or identified by the PCM.
3. Upon completion of the boot-up sequence the AQD is ready for use and will proceed to the loop display sequence.

AQD - ATSC/QAM Demodulator

Loop Display Sequence & Left/Right Sequence

After the unit has displayed the boot-up sequence it proceeds to the loop sequence. In this mode the LCD displays the actual module status as depicted by the right column in the diagram below. This is referred to as the loop sequence because this information is constantly displayed in a scrolling fashion on the LCD readout. The loop sequence may be interrupted at any time by pressing the any of the arrow keys. The diagram is divided into 8 rows to reflect the eight respective modules that can populate the rack chassis. Information for Modules Not Present is not displayed during the loop sequence.



AQD - Left/Right Sequence

The Left/Right Sequence will display two basic LCD screens for each installed module. This information will be displayed when a user depresses the ◀ (L) or ▶ (R) arrow navigation keys. The AQD NOT PRESENT LCD messages will only be displayed when using the ◀ (L) or ▶ (R) arrow keys. Then L/R Sequence allows the user to scroll to a particular module to which specific setting adjustments are desired in the Interactive ▲ (UP) / ▼ (DN) Menu.

AQD - ATSC/QAM Demodulator

Left/Right Sequence Details

- SNR is displayed when an AQD module locks to an input program channel and indicates the signal to noise ratio of the input signal and is expressed in dB. The following are the desired input SNR ranges for the appropriate signal modulation type:

	8VSB	64 QAM	256 QAM
Excellent =	>30 dB	>38 dB	>38 dB
Good =	25—30 dB	30—38 dB	35—38 dB
Marginal =	18—25 dB	23—30 dB	30—35 dB
Non-Functional =	<18 dB	<23 dB	<30 dB

- NO PROGRAM will be displayed if a valid lock is acquired but no program signal is actually being detected
- NO SIGNAL indicates that the input signal was not detected (no RF input)
- PLEASE SCAN indicates a scan was not performed or is required again
- AUDIO ONLY indicates no video signal
- NO AUDIO indicates no audio signal present
- SCRAMBLED PRG indicates the signal has encryption

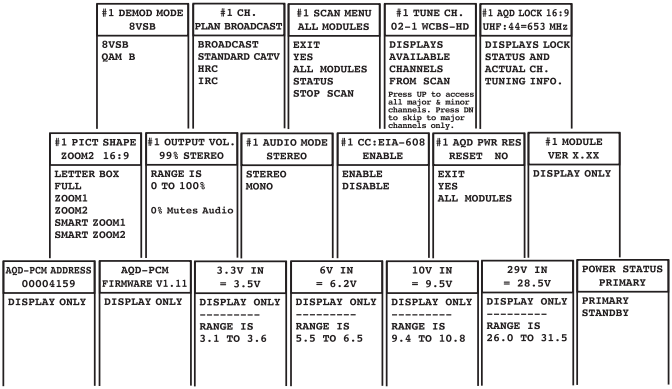
NOTE: The AQD Not Present message will be displayed when the optional Remote Configuration Server (RCS) Module is installed in a particular chassis slot.

```
#8 AQD
NOT PRESENT
```

AQD - ATSC/QAM Demodulator

Interactive & Up/Down Sequence

The interactive menu is easily accessible by depressing the ▲ (UP) or ▼ (DN) arrow keys on the front of the control module. The user may scroll through the menu screens depicted by continuing to press the up and down navigation keys. The following diagram depicts the available variables with the modify options listed below. See the following page for specific variable function details.



AQD - LCD Interactive Variable Sequence

Programming a Variable

1. Use the ◀ (L) or ▶ (R) arrow navigation keys to scroll to the installed module you desire to adjust.
2. Press the ▲ (UP) or ▼ (DN) arrow navigation keys to scroll to the desired interactive variable.
3. When a user arrives at a screen whose variable needs to be changed, the user should depress the ENTER button until the blinking cursor is displayed.
4. After the blinking cursor is displayed the user simply presses the ▲ (UP) or ▼ (DN) arrow buttons to increment or decrement to the appropriate desired value.
5. When the user reaches the desired value the user should press the ENTER button again to apply the change to the PCM memory. The PCM then programs the corresponding module to the new setting.
6. The LCD displays an affirmative response after information is entered correctly for several of the variables. The controller will display the "Entry Accepted" response as demonstrated below.

Entry Accepted

Variable Details

DEMOD MODE: The AQD is capable of locking to a terrestrial (off-air) 8VSB or CATV QAM Annex B modulated RF input signal. The selection of the appropriate signal type must be made by the user to ensure signals are properly identified during a scan. By setting the Demod Mode the Channel Plan is automatically set to Broadcast for 8VSB signals and Standard CATV for QAM signals or 8VSB signals on the CATV channel plan.

CHANNEL PLAN: The Channel Plan mode allows the user to the select the appropriate frequency mode. This setting alerts the user to the appropriate center frequency plan the AQD will use during the scan process.

- The Broadcast option must be selected for off-air 8VSB reception, this is automatically set if the Demod Mode is set to 8VSB. Reception is limited to VHF & UHF center frequencies.
- The Standard CATV mode is capable of locking to QAM Annex B and 8VSB signals. This channel plan is automatically set when the QAM B mode is selected in the Demod Mode command menu. Reception is limited to CATV center frequencies.

o It is only required to choose the HRC or IRC option when these frequency off-sets are used with the CATV plan.

➢ NOTE: See Appendix for additional details.

SCAN MENU: The scan menu command allows the AQD module to auto search for available programming. It is required that each module perform a scan in order to function properly. All modules will perform a scan when the Scan All Modules command is selected.

- **YES –** The YES Command performs a scan on only the selected active module
- **ALL MODULES –** The ALL MODULES Command performs a new scan on all of the installed modules
- **STATUS –** The STATUS Command displays the channels found during the scan process for the selected active module
- **STOP SCAN –** The STOP SCAN Command permits an operator to stop an in-process scan. It is important to note that once a scan starts the previously found channel data is immediately erased. If the scan is stopped, only the completed scan channel data will be available for selection
- **EXIT –** The EXIT Command exits the scan menu without making any modifications

AQD - ATSC/QAM Demodulator

```
#2 SCAN
IN PROGRESS
```

The unit will display the SCAN IN PROCESS message during the scan process if interaction is attempted within the active scanning AQD module.

TUNE CHANNEL: The Tune Channel command allows a user to select the desired program from the list of available channels from the unit scan. To select a program scroll to the desired item in the channel list and press the Enter key.

- Depress the ▲ (UP) arrow navigation key to scroll through all the available channels (major and minor sub-channel)
- Depressing the ▼ (DN) arrow navigation key permits faster tuning by 'jumping' to each major channel available from the scan.

o Tuning to the desired minor sub-channel is then easy by pressing the ▲ (UP) arrow navigation key

The LCD will show the ENTRY ACCEPTED message and all TV's will briefly display a banner at the top of the screen. The banner contains the major & minor sub-channel designation and the time (time displayed comes from the broadcast stream).

AQD STATUS - The AQD Status command screen displays valuable status information on the selected program channel. Signal Status:

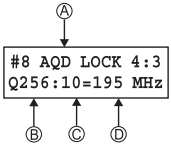
A. **LOCK** is indicated when a valid signal acquisition has been achieved by the AQD module as well as the signal aspect ratio.

NOT LOCKED will be displayed if the module fails to acquire the desired program signal Channel Frequency Data:

B. INPUT SIGNAL TYPE IS DISPLAYED – Such as UHF or 64 or 256 QAM

C. THE INPUT SIGNAL CH. IS DISPLAYED – for example, CH 44

D. **THE CORRESPONDING FREQUENCY FOR THE INPUT CH. –** 653 MHz for CH 44 UHF



AQD - ATSC/QAM Demodulator

PICTURE SHAPE:

The AQD operator can adjust the picture shape to the desired setting for converting 16:9 images to 4:3 images as required for traditional television ratio viewing.

(**The Smart Zoom 2 setting is recommended in most applications**)

- **FULL** displays the entire picture while stretching vertically to fit the screen and may present with black bars at the sides
- **LETTER BOX** displays the entire picture image and presents with black bars on top/bottom and left/right to fit the screen
- **ZOOM 1** has a vertical/horizontal cut with black bars
- **ZOOM 2** has a vertical/horizontal cut without black bars
- **SMART ZOOM 1** is a modified version of ZOOM 1 to adjust to differences in the picture shape data sent by a broadcaster
- **SMART ZOOM 2** expands the image to fit the screen while cropping some images on the left/right and presents without black bars

➢ **NOTE:** See Appendix B for additional details on picture shape (Screen Aspect Ratio).

```
#2 PICTURE SHAPE
WARNING —> 4:3
```

If the incoming signal is 4:3 Format, the unit will display a warning message to alert the operator that no effect will be made by changing the picture shape. The change will still be permitted, but is not recommended.

AQD - ATSC/QAM Demodulator

OUTPUT VOLUME: The output volume can be adjusted within a range of 0 to 100%.

AUDIO MODE: The audio mode command allows for the selection of mono or stereo audio.

➢ **NOTE:** It is extremely important to change the AUDIO MODE to mono if using a non-stereo (mono) modulator in conjunction with the AQD unit. This will present the full combined mono audio output on both RCA connectors.

CC:EIA-608: This is the Closed Captioning command mode. The closed captioning, also known as line 21 captions is per EIA-608, the standard for Closed Captioning for NTSC Broadcasts in the United States. An operator can globally enable or disable closed captioning for each module eliminating the need to adjust individual TV viewing locations.

AQD PWR RESET: The AQD Power Reset command allows an operator to reset the power or "cold boot" an individual or all the modules installed in a rack. To perform a reset for a single module navigate to the AQD Power Reset command for that particular module (the module number is displayed first on each LCD screen), then press the Enter key, when the blinking cursor appears press the up/down arrow keys to toggle to the YES entry, Press Enter to select. A reset to all modules can be performed at any module reset command screen.

AQD - ATSC/QAM Demodulator

AQD Quick Set-Up Instruction Guide

The Quick Set-Up instructions are provided as a checklist of the minimum steps required to install and program the ATSC/QAM Demodulator.

1. Verify RF input levels
   a. Signal acquisition range is -20 to +20 dBmV — -10 to +10 dBmV is the desired optimum level
2. Verify all cable connections — (Refer to page 11 for detailed instructions)
   a. Check to make sure the power/data cables are connected to the correct location on the PCM and the respective modules to ensure proper communication
3. Program the appropriate DEMOD MODE for each module — *8VSB or QAM* (Refer to page 16 for detailed variable instructions)
4. Program the appropriate CHANNEL PLAN for each module — *Broadcast, Standard CATV, HRC or IRC*
5. Perform a SCAN on each or all modules — *it is not recommended to operate the unit when a scan is in process*
   a. A scan must also be performed each time the Demod Mode is changed
6. Program the appropriate desired channel in the TUNE CHANNEL menu sequence
   a. **NOTE: A scan must be performed prior to selecting a program channel**

AQM - Agile QAM Modulator

The AQM is designed to accept a DVB ASI (Asynchronous Serial Interface) digital transport stream and modulate it into a QAM (Quadrature Amplitude Modulation) signal. The QAM modulator in the AQM achieves state-of-the-art performance with capabilities to improve bandwidth efficiency by supporting advanced QAM modes like 256, 512 & 1024 QAM. Plus, the built in advanced bit stuffing circuitry ensures that Null Packets are inserted into the ASI transport stream if needed to ensure the correct baud rate is transmitted.

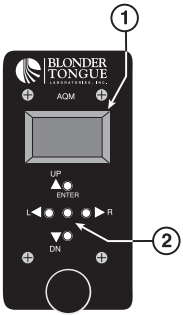
Excellent RF performance is vital to the health of every cable system. Incorporating digital signals into that cable system increases the complexity required to keep it operating smoothly. The AQM's integrated upconverter is designed to accomplish this very goal. The BT Agile QAM Modulator incorporates a custom design approach utilizing the latest generation technology available to ensure extremely low phase noise and a highly stable output signal. This eliminates the hassles and potential for problems caused by module based interconnects, especially when using products without integrated upconverters.

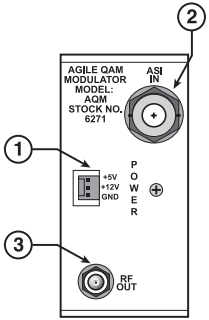
The AQM is easily accommodated in Blonder Tongue's standard HE Series of micro-modular rack chassis units (MIRC-12V) and the MIPS power supply units. This allows existing modulators or demodulators to coexist effortlessly.

Features

- AQM Unit Integrates the QAM Modulator and a High Performance Upconverter
- Compact Design allows 6 Modules in a 2 RU Rack Chassis
- DVB ASI Input, Complies with DVB ASI Standards
- Improve Bandwidth Efficiency with Support for All Advanced QAM Modes including, 256, 512 & 1024 QAM
- Agile QAM Output 54—864 MHz, (NTSC Mode Channel 2—135 & 12.5 kHz Steps in MHz Frequency Mode)
- NTSC & PAL B/G Capable
- Self Test PRBS Mode Built In
- Optional IF Output Available via Special Order
- Optional LVDS Input Available via Special Order

AQM - Agile QAM Modulator





Unit Front Panel

1. **LCD Display** - 2 line Liquid Crystal Display screen used to interact with user to display unit information.
2. **Push Button Navigation Controls** - Buttons used to navigate between menus and enter unit information.

Unit Rear Panel

1. **Power** - 3 pin female connector used to plug-in cable for respective modulator to deliver power.
2. **ASI IN** - BNC connector for ASI (Asynchronous Serial Interface) input.
3. **RF OUT** - 75 Ohm QAM RF Output.

Boot-Up Display Sequence

When the unit is in Normal Mode and is first plugged in for use, the AQM checks for the presence of input data. If data is not detected, it displays the appropriate module condition on the LCD readout as depicted below.

NO INPUT DATA

If unit is set to CW or Off Mode, the following will be displayed by the LCD. **Note:** Factory default values depicted in Box

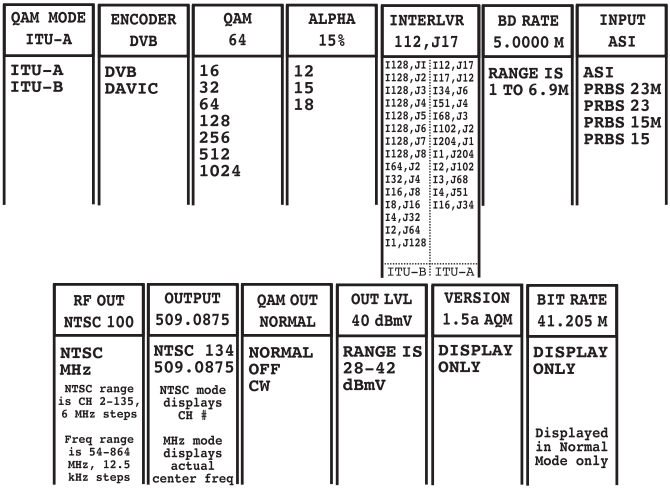
QAM OUT CW	QAM OUT OFF

AQM - Agile QAM Modulator

Main Interactive Sequence

The main interactive sequence is where all the core module programming is performed. This sequence is accessed anytime a user depresses one of the ◀ (L) or ▶ (R) and ▲ (UP) ▼ (DN) arrow navigation keys. The following diagram depicts the LCD screens available in the main interactive sequence.

Note: Factory Reset Default values depicted in illustration.



AQM - Agile QAM Modulator

Programming a Variable

1. When a user arrives at a screen whose variable needs to be changed, the user depresses the ENTER button until the blinking cursor is displayed.
2. After the blinking cursor is displayed the user simply presses the ▲ (UP) or ▼ (DN) arrow buttons to increment or decrement to the appropriate desired value.
3. When the user reaches the desired setting the ENTER button is pressed again to save the change, then the corresponding AQM module stores the new information.

Interactive Sequence Detail

QAM Mode

The AQM can be set to comply with the ITU-TJ-83 Annex A & Annex B specifications.

ITU-A - is used for DVB operation

ITU-B - is used for DigiCiper II operation

Encoder

The Encoder selection is only used in ITU-A Mode. If set to ITU-B Mode, then the Encoder shows NONE.

QAM

The QAM modulation type is user selectable. If the unit is set to ITU-B Mode, then only QAM 64 or 256 are available.

Alpha

The Alpha setting is used to set the roll-off factor. Settings are typical depending on the Operation Mode. The standard settings are as follows:

ITU-A - 15%

ITU-B - 18%

AQM - Agile QAM Modulator

Interleaver

The Convolutional Interleaver is user selectable. Various choices are available depending on the Operation Mode.The standard settings are as follows:

ITU-A - I 12, J17

ITU-B - I 128, J1

Baud Rate

The Baud Rate needs to be programmed based on the Input Data and QAM Mode used. The range is from 1 to 6.9 MBaud.

Input

The AQM Input Signal is fed to the module via the BNC connector on the rear panel. ASI (Asynchronous Serial Interface) data is typically used. The unit is also programmed with the ability to generate a PRBS (Pseudo Random Binary Sequence) test signal. The PRBS signal is a polynomial sequence that is determined by the Input Selection choice. The following settings are available.

PRBS 25M

PRBS 23

PRBS 15M

PRBS 15

These selections are also valuable if an Input ASI signal is not available. This can be helpful in balancing the Output Level of several units without the need for an Input ASI signal.

AQM - Agile QAM Modulator

RF OUT

The unit presents a fully modulated QAM RF output. There are two modes that determine the upconversion programming.

NTSC: The NTSC mode permits programming the RF output using a standard NTSC channel number.

MHz: The MHz or Frequency Tuning mode permits programming the RF output to the desired frequency.

Output

In the NTSC Mode it can be upconverted in 6 MHz increments to any NTSC standard channel, 2-135 (center frequency). See Appendix A for Frequency details.

In the MHz or Frequency Mode it can be upconverted to any desired frequency in 12.5 kHz increments. Press the ▲ (UP) or ▼ (DN) arrow buttons to increment or decrement to the appropriate desired value for each digit, press and hold the button to quickly scroll.

QAM Out

The unit has three QAM modes.

NORMAL: The NORMAL QAM mode outputs a QAM modulated signal.

OFF: The OFF QAM mode outputs no signal from the module.

CW: The CW QAM mode outputs a CW signal that is very useful for measuring the output level of the unit. (See the QAM Signal Level Testing section for more detail).

Output Level

The AQM features electronic output level control.

- Can be adjusted in any of the QAM modes listed above.
- Displayed and measured as an average value. (See the QAM Signal Level Testing section for more detail).
- QAM CW output level is a true representation of a QAM signal level.

The output level range is +30 dBmV to +40 dBmV.

NOTE: For optimum noise performance, output level for each module should be set nominally at +40 dBmV.

AQM - Agile QAM Modulator

Bit Rate

This is the actual input date rate that the QAM signal is locked to. This is only displayed in the QAM Out Normal Mode.

Factory Reset

The unit has a "Factory Reset" capability built in that allows a user to erase all the current programming information for the AQM and restore it to it's factory default setting.

To perform this function, press and hold the ENTER and ▼ (DN) arrow navigation keys simultaneously until the LCD displays "Factory Reset" and then release. This will cause the unit to reset the programmed information to the factory default settings shown in the Main Interactive Sequence illustration on page 10.

Factory Reset

CAUTION

This will reset all programming information for the unit and is only recommended when an error condition is displayed by the LCD that cannot be corrected by a normal power cycle!

AQT - ATSC to QAM Transcoder

The Blonder Tongue ATSC to QAM Transcoder is a modular unit that allows the reception of a modulated 8VSB or QAM signal input and transcodes it to a QAM modulated output signal. The unit is designed to tune to an off-air 8VSB or QAM digital signal and convert it to a digital QAM signal to permit interface with digital TV displays with QAM tuners.

Applications

Digital channel processing including:

- Changing the incoming QAM channel to a different RF QAM channel
- Complete regeneration of a QAM input for optimal MER performance
- Convert one off-air ATSC 8VSB signal to a QAM output

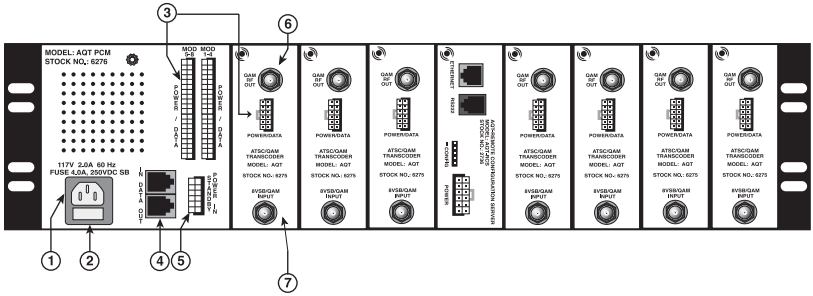
Features

- 8VSB, 16VSB, Annex A QAM 16, 32, 64, 128 & 256 and Annex B QAM 64 & 256 Modulated RF Input Transport Streams Supported
- Modular & Compact Units Permit High Density — 8 Modules in 3 Rack Height
- Easy Set-up & Configuration via Front Panel LCD Controls
- Remote Computer Control Capability via Internet or RS-232 Interface
- Fully Agile QAM output frequency range of 54-864 MHz
- No multiplexing or changing of any MPEG table is performed with this unit
- In normal mode Null Packet Processing is performed
- Pass thru mode disables any Null Packet Processing

Unit Front Panel

1. **Unit Status Indicator -** Provides feedback to user based on the following LED indications:
   Solid Green LED - Indicates valid lock to the RF input signal and valid lock to the RF output
   Flashing Green LED - Indicates not locked status on either RF input or RF output
2. **Backlit LCD -** 16 character, 2 line Liquid Crystal Display screen used to interact with user to display unit information
3. **Push Button Navigation Controls -** Buttons used to navigate between menus and set variables

Unit Rear Panel



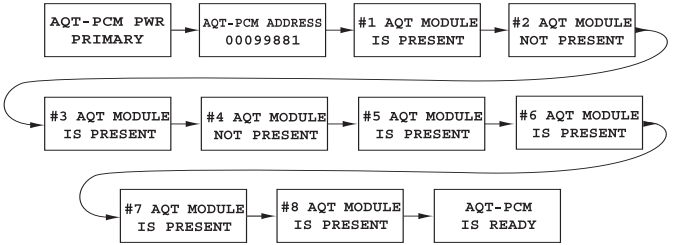
1. **Power Cord Socket** - The unit power cord plug socket
2. **Fuse Holder** - 4.0 Amp., 250V DC, Slo Blo fuse
3. **Module Power/Data Cable Sockets** - Sockets for power/data cable use, PCM unit is equipped with two 50-pin female connectors and AQT module is equipped with a 12-pin female connector. Use supplied power/data cables to connect the PCM unit to the appropriate module, ensure proper wiring by module number slot
4. **RS232 Serial Data Ports** - Used to plug into and daisy chain AQT-PCM units for remote monitoring and configuration
5. **Standby Power In** - 12-pin female connector used to plug-in the optional Standby Power unit
6. **QAM RF Out** - RF Connector with QAM modulated output signal
7. **8VSB/QAM Input** - RF Connector for feeding appropriate 8VSB off-air or QAM modulated RF input signal

AQT - ATSC to QAM Transcoder

Operating Interface Instructions

Boot-Up Display Sequence

When the unit is first plugged in for use, the PCM displays the appropriate module condition on the LCD readout as depicted below.


AQT-PCM PWR PRIMARY
AQT-PCM ADDRESS 00099881
#1 AQT MODULE IS PRESENT
#2 AQT MODULE NOT PRESENT
#3 AQT MODULE IS PRESENT
#4 AQT MODULE NOT PRESENT
#5 AQT MODULE IS PRESENT
#6 AQT MODULE IS PRESENT
#7 AQT MODULE IS PRESENT
#8 AQT MODULE IS PRESENT
AQT-PCM IS READY

AQT - Boot-Up Display Sequence

1. Each control module has a unique module address that is set at the factory which is displayed immediately following the primary or secondary power source status. This address is used for remote software capability only using AQT-RCS (Stock # 2736).
2. Each module status is identified and reported on the LCD. If a module is identified it is listed as "PRESENT" or "NOT PRESENT" if not connected or identified by the PCM.
3. The AQT "NOT PRESENT" message will be displayed when the optional Remote Configuration Server (RCS) Module is installed in a particular chassis slot.
4. Upon completion of the boot-up sequence the AQT-PCM is ready for use and will proceed to the loop display sequence.
5. DO NOT push any switches on the control module during this sequence, as it will NOT respond until it displays "AQT-PCM IS READY".

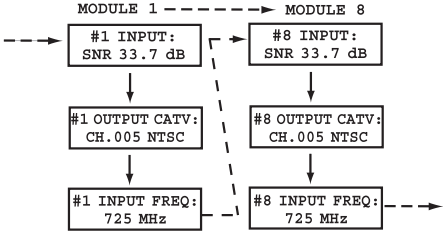
AQT - ATSC to QAM Transcoder

Loop Display Sequence

After the unit has displayed the boot-up sequence it proceeds to the loop sequence. In this mode the LCD displays the actual module status as depicted by the diagram below. This information is referred as the loop sequence because this information is constantly displayed in a scrolling fashion on the LCD readout. The loop sequence may be interrupted at any time by pressing any of the arrow keys. In the loop sequence the back light LCD is off; however, after pressing any navigation button the backlight automatically turns on for ease of viewing.

During the loop sequence the LCD displays 3 valuable parameters for each installed (present) AQT module. Modules "NOT PRESENT" will not have information displayed during the loop sequence.

- Input: Displays the actual input signal to noise ratio (SNR) if locked
- Output: Displays the channel number the output is programmed
- Input Freq: Displays the center frequency of the input signal programmed

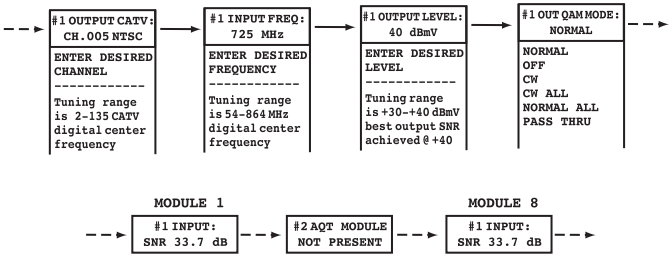


AQT - LCD Loop Display Sequence

AQT - ATSC to QAM Transcoder

Left/Right Sequence Details

The Left/Right sequence is where the core variables of the AQT are programmed. It is accessed when a user depresses the ◀ (L) or ▶ (R) arrow navigation keys. There are 4 main adjustable variables for each module.



AQT - LCD Left/Right Variable Sequence

AQT - ATSC to QAM Transcoder

- **OUTPUT CATV** — permits the entry of the desired output channel number to program the AQT module, tuning range is NTSC CATV channel 2—135, (digital center frequency)
- **INPUT FREQ** — permits the entry of the desired input signal center frequency to program the AQT module, tuning in frequency range of 54—864 MHz, (digital center frequency)
- **OUTPUT LEVEL** — permits the entry of the desired output signal level in dBmV as an average power measured signal, range is +30 to +40 dBmV, optimum SNR performance is achieved by setting the unit output @ +40 dBmV
- **OUT QAM MODE** — permits the entry of the desired QAM mode, the unit has six available QAM modes:
  - **NORMAL**: The "NORMAL" QAM mode outputs a 6 MHz QAM modulated signal and must be used with 8VSB input
  - **OFF**: The "OFF" QAM mode outputs no signal from the module (When a module is placed in the QAM off mode, the status LED indicator will blink)
  - **CW**: The "CW" (carrier wave) mode outputs a CW signal that is very useful for measuring the output level of the unit, the CW signal is a true representation of the QAM signal level (When a module is placed in the QAM CW mode, the status LED indicator will blink) (See the QAM Signal Level Testing section for more detail)
  - **CW ALL**: Puts all modules installed in a rack chassis into CW mode for ease of level adjustment
  - **NORMAL ALL**: Returns all modules installed in a rack chassis to normal mode required for normal operation
  - **PASS THRU**: Disables null packet processing - This mode must be used when the input to the AQT is QAM

AQT - ATSC to QAM Transcoder

Each of the modules are displayed in order by scrolling through the sequence to find the desired variable on a respective installed module. Modules not installed are listed by the "MODULE IS NOT PRESENT" message. The SNR value for each module is displayed together for each of the installed eight modules at the end of the sequence.

- SNR is displayed when an AQT module locks to an input program channel and indicates the signal to noise ratio of the input signal and is expressed in dB. The following are the desired input SNR ranges for the appropriate signal modulation type:

	8VSB	64 QAM	256 QAM
Excellent =	>30 dB	>38 dB	>38 dB
Good =	25—30 dB	30—38 dB	35—38 dB
Marginal =	18—25 dB	23—30 dB	30—35 dB
Non-Functional =	<18 dB	<23 dB	<30 dB

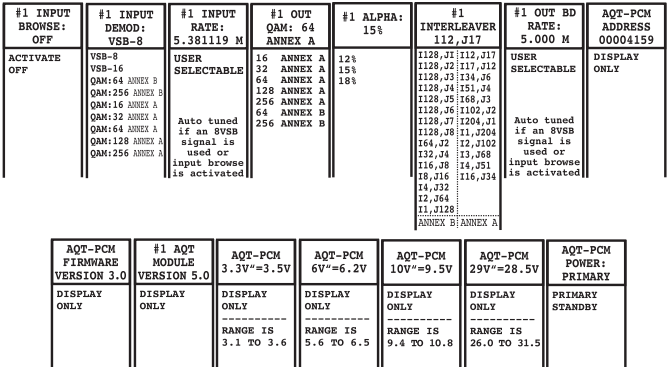
Programming a Variable

1. Use the ◀ (L) or ▶ (R) arrow navigation keys to scroll to the installed module you desire to adjust.
2. Press the ▲ (UP) or ▼ (DN) arrow navigation keys to scroll to the desired interactive variable.
3. When a user arrives at a screen whose variable needs to be changed, the user should depress and hold the ENTER button until the blinking cursor is displayed.
4. After the blinking cursor is displayed the user simply presses the ▲ (UP) or ▼ (DN) arrow buttons to increment or decrement to the appropriate desired value.
5. When the user reaches the desired value the user should press the ENTER button again to apply the change to the PCM memory. The PCM then programs the corresponding module to the new setting.

AQT - ATSC to QAM Transcoder

Interactive & Up/Down Sequence

The advanced interactive menu is easily accessible by depressing the ▲ (UP) or ▼ (DN) arrow keys on the front of the control module. Each of the adjustable settings are issued to the particular module that is actively displayed. Some variables are global for the unit and not module specific. The user may scroll through the menu screens depicted by continuing to press the up and down navigation keys. The following diagram depicts the available, advanced variables with the modify options listed below.



AQT - LCD Interactive Variable Sequence

AQT - ATSC to QAM Transcoder

- INPUT BROWSE — when "activated" the input browse function automatically scans the input signal for the 8VSB/QAM rates as per the chart below. Then, if found, automatically sets the input and output parameters. If no valid signal is found it will default to the last locked state. Factory default is 8VSB.
- INPUT DEMOD — permits the selection of any of the listed input demod modes, the unit is factory set for 8VSB signals
- INPUT RATE — permits the entry of the desired input baud rate, this is automatically set to one of the factory values listed above (input browse) if a standard 8VSB input signal is used or the input browse function is activated
- OUT QAM — permits the entry of the desired output QAM mode, the unit has six available QAM modes
- ALPHA — permits the entry of the appropriate alpha setting to match the output QAM mode
- INTERLEAVER — permits the entry of the appropriate interleaver setting to match the output QAM mode
- OUT BD RATE — permits the entry of the desired output QAM baud rate. The QAM output baud rate is automatically set to the corresponding values for the respective input baud rate as listed in the chart below.

INPUT RATE	OUTPUT RATE
VSB-8: 5.3811 Mbaud	QAM 64-B: 5.0569 Mbaud
VSB-16: 5.3811 Mbaud	QAM 256-B: 5.3605 Mbaud
QAM 64-B: 5.0569 Mbaud	QAM 64-B: 5.0569 Mbaud
QAM 256-B: 5.3605 Mbaud	QAM 256-B: 5.3605 Mbaud
QAM 16-A: 5.0000 Mbaud	QAM 16-A: 5.0000 Mbaud
QAM 32-A: 5.3333 Mbaud	QAM 32-A: 5.3333 Mbaud
QAM 64-A: 5.0000, 4.4444 or 3.3333 Mbaud	QAM 64-A: 5.0000, 4.4444 or 3.3333 Mbaud
QAM 128-A: 5.0000 or 4.7619 Mbaud	QAM 128-A: 5.0000 or 4.7619 Mbaud
QAM 256-A: 5.5895 Mbaud	QAM 256-A: 5.5895 Mbaud

* In prder for the input browse to work, Input/Output parameters are paired and must match this chart.

AQT - ATSC to QAM Transcoder

AQT Quick Set-Up Instruction Guide

The Quick Set-Up instructions are provided as a checklist of the minimum steps required to install and program the AQT.

1. Verify all cable connections
   a. Check to make sure the power/data cables are connected to the correct location on the PCM and the respective modules to ensure proper communication
   b. Check to make sure the correct RF cable is connected to the Input and Output F connector
2. Verify RF input levels
   a. Signal acquisition range is -20 to +20 dBmV — -10 to +10 dBmV is the desired optimum level
3. Program the desired Input Frequency for each appropriate module — *Tuning Range 54-864 MHz*
4. Program the desired Output Channel for each appropriate module — *Tuning Range CATV 2-135*
   a. +40 dBmV is recommended for optimum level for SNR performance
5. Verify the Module Lock state — *Press the ▶ (R) arrow key until the SNR value is shown for the appropriate module*
   a. If not locked, activate the Input Browse mode for the module, this will auto search & tune all pre-programmed modes
   b. Verify input signal level, feed/cable

   NOTE: Repeat as appropriate for each module

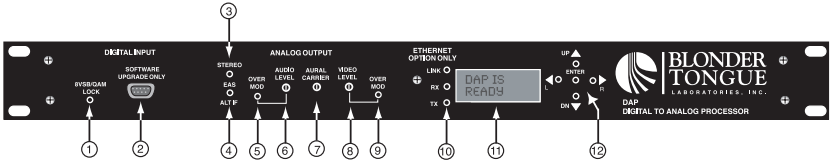
DAP - Digital to Analog Processor

The Digital to Analog Processor (DAP) is a complete single channel solution for delivering digital television programming over existing analog networks. The DAP is housed in a one rack high unit and features a backlit 2 x 16 character LCD screen and push button navigation switches to allow interaction with the simple to follow user menu functions for programming. Input and output tuning is easily accomplished with either the front panel menu interface or via the optional Remote Network Card; only one RNC per headend is needed for complete configuration and control of all DAPs that are daisy chained in the headend. The DAP supports standard EIA CATV, IRC, HRC and Broadcast channel plans in the 54—864 frequency range. All channel frequency information, with appropriate FCC offsets, is pre-programmed and tuned electronically via microprocessor. The unit is also equipped with the Emergency Alert System (EAS) feature which can also be used as an alternate IF input.

Features

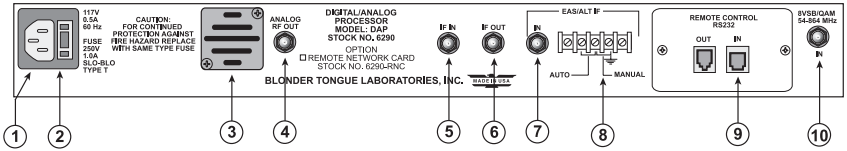
- Decodes HDTV or SDTV Digital Signals and Modulates to Analog for Transmission to Traditional Televisions
- Accepts All ATSC Digital Input Standards, 8VSB, 64 QAM, 256 QAM
- Outputs All Broadcast and CATV Channel Assignments in the 54-864 MHz Range
- Remotely Configure All DAPs in a Headend with Optional Remote Network Card in one DAP unit
- Perfect Digital Transition Solution to Offer Analog Versions from Digital Sources
- +60 dBmV Output
- EAS IF Input

Unit Front Panel



1. **Unit Status Indicator** - Provides feedback to user based on the following LED conditions:
   Solid Green LED indicates valid lock to the RF input signal
   Flashing Green LED indicates NOT LOCKED or SCANNING in process
2. **9-Pin RS-232 Connector** - Used for future software upgrade of digital input section only
3. **Stereo LED** - Green stereo LED light
4. **EAS/ALT Indicator** - Red LED when EAS/ALT IF is active
5. **Audio Over Modulation LED** - Lights when peak deviation of aural carrier is over 25 kHz
6. **Audio Modulation Level** - Adjusts aural carrier modulation
7. **Aural Carrier** - Controls amplitude of aural RF carrier relative to visual RF carrier
8. **Video Modulation Level** - Adjust percentage of modulation
9. **Video Over Modulation LED** - Lights when modulation is above 87.5%
10. **Ethernet Link, Receive and Transmit LED** - LED indicator for optional ethernet connectivity. The LED's will only light if RNC option is installed and in use, without RNC installed all LED's will be off.
11. **Backlit LCD** - 16 character, 2 line Liquid Crystal Display screen used to interact with user to display unit info
12. **Push Button Navigation Controls** - Buttons used to navigate between menus and operate the unit

Unit Rear Panel



1. **Power Cord Socket** - The Unit Power Cord Plug Socket
2. **Fuse Holder** - 1.0 Amp., 250V DC, Slo Blo Fuse
3. **Air Circulation Fan**
4. **Analog RF Out** - NTSC Analog Output via "F" Connector
5. **IF IN** - "F" Connector IF Input
6. **IF OUT** - "F" Connector IF Output
7. **EAS/ALT IF** - "F" Connector for Emergency Alert System/ALT IF
8. **EAS/ALT IF Terminal Strip** - Terminal Connector for Auto/Manual EAS
9. **Optional RS232 Computer Control** - RJ-11 Connector, used to daisy chain DAP for optional computer control. Requires Remote Network Card (not shown) to be installed in one DAP unit per headend.
10. **8VSB/QAM INPUT** - RF Connector for feeding appropriate 8VSB off-air or QAM modulated RF input signal

DAP - Digital to Analog Processor

Boot-Up Display Sequence

When the unit is first plugged in for use, the DAP displays the appropriate module condition on the LCD readout as depicted below.

Boot-Up Display Sequence

1. Each DAP unit has a unique digital address that is set at the factory which is displayed immediately following the power status initialization. This address is used for remote software capability only.
2. Upon completion of the boot-up sequence the DAP is ready for use and will proceed to the loop display sequence.

CAUTION

DO NOT push any switches on the control module during this sequence as it will NOT respond until it displays "DAP IS READY".

DAP - Digital to Analog Processor

Main LCD Lock Display

After the unit has displayed the boot-up sequence it will display the main LCD lock display. In this mode the LCD displays the actual status as depicted in the diagram below. The LCD lock display may be interrupted at any time by pressing the any of the arrow keys.

DAP - Main LCD Display

Left/Right Sequence Details

The Left/Right Sequence will display four basic LCD screens. This information will be displayed when a user depresses the ◀ (L) or ▶ (R) arrow navigation keys.

IMPORTANT — No unit adjustments are permitted in the ◀ (L) or ▶ (R), all modifications must be performed in the ▲ (UP) / ▼ (DN) sequence.

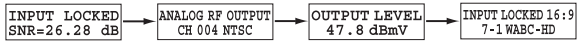
- SNR is displayed when the DAP locks to an input program channel and indicates the signal to noise ratio of the input signal and is expressed in dB. The following are the desired input SNR ranges for the appropriate signal modulation type:

	8VSB	64 QAM	256 QAM
Excellent =	>30 dB	>38 dB	>38 dB
Good =	25—30 dB	30—38 dB	35—38 dB
Marginal =	18—25 dB	23—30 dB	30—35 dB
Non-Functional =	<18 dB	<23 dB	<30 dB

- NO SIGNAL indicates that the input signal was not detected (no RF input)
- PLEASE SCAN indicates a scan was not performed or is required again
- AUDIO ONLY indicates no video signal
- NO AUDIO indicates no audio signal present
- SCRAMBLED PRG indicates the signal has encryption
- NO PROGRAM will be displayed if a valid lock is acquired but no program signal is actually being detected

DAP - Digital to Analog Processor

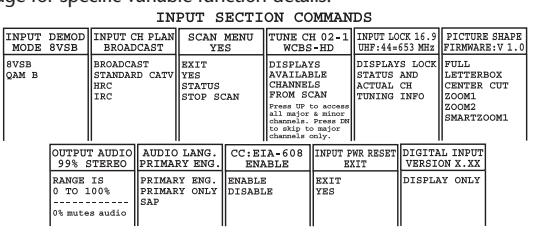
The Unit LED has a backlit feature to illuminate the panel. It will illuminate when any of interactive buttons are pressed. It will automatically turn off if no button interaction is made after 10 seconds.

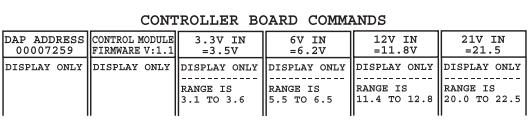


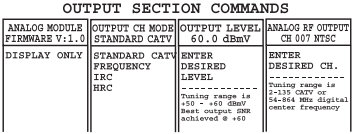
DAP - Left/Right Display

Interactive & Up/Down Sequence

The interactive menu is easily accessible by depressing the ▲ (UP) or ▼ (DN) arrow keys on the front of the DAP unit. The user may scroll through the menu screens depicted by continuing to press the up and down navigation keys. The following diagram depicts the available variables with the options listed below. See the following page for specific variable function details.







DAP - LCD Interactive Variable Sequence

DAP - Digital to Analog Processor

Programming a Variable

1. Press the ▲ (UP) or ▼ (DN) arrow navigation keys to scroll to the desired interactive variable.
2. When a user arrives at a screen whose variable needs to be changed, the user should depress the ENTER button until the blinking cursor is displayed.
3. After the blinking cursor is displayed the user simply presses the ▲ (UP) or ▼ (DN) arrow buttons to increment or decrement to the appropriate desired value.
4. When the user reaches the desired value the user should press the ENTER button again to apply the change to the unit memory. The control board then programs the unit to the new setting.
5. The LCD displays an affirmative response after information is entered correctly for several of the variables. The controller will display the ENTRY ACCEPTED response as demonstrated below.

Entry Accepted

Variable Details

INPUT DEMOD MODE:

The DAP is capable of locking to a terrestrial (off-air) 8VSB or CATV QAM Annex B modulated RF input signal. The selection of the appropriate signal type must be made by the user to ensure signals are properly identified during a scan. By setting the DEMOD MODE the CHANNEL PLAN is automatically set to BROADCAST for 8VSB signals and STANDARD CATV for QAM signals or 8VSB signals on the CATV channel plan.

DAP - Digital to Analog Processor

INPUT CH PLAN:

The CHANNEL PLAN mode allows the user to the select the appropriate frequency mode. This setting alerts the user to the appropriate center frequency plan the DAP will use during the scan process.

- The BROADCAST option must be selected for off-air 8VSB reception, this is automatically set if the DEMOD MODE is set to 8VSB. Reception is limited to VHF & UHF center frequencies.
- The STANDARD CATV mode is capable of locking to QAM Annex B and 8VSB signals. This channel plan is automatically set when the QAM B mode is selected in the DEMOD MODE command menu. Reception is limited to CATV center frequencies.
  - o It is only required to choose the HRC or IRC option when these frequency off-sets are used with the CATV plan.

SCAN MENU:

The SCAN MENU command allows the DAP unit to auto search for available programming. It is required to perform a scan in order to function properly.

- YES – The YES command performs a scan of the incoming available signals by the DAP unit
- STATUS – The STATUS command displays the channels found during the scan process
- STOP SCAN – The STOP SCAN command permits an operator to stop an in-process scan. It is important to note that once a scan starts the previously found channel data is immediately erased. If the scan is stopped, only the completed scan channel data will be available for selection
- EXIT – The EXIT command exits the SCAN MENU without making any modifications

The unit will display the SCAN IN PROCESS message during the scan process if interaction is attempted.

DAP - Digital to Analog Processor

TUNE CHANNEL:

The TUNE CHANNEL command allows a user to select the desired program from the list of available channels from the unit scan. To select a program scroll to the desired item in the channel list and press the Enter key.

- Depress the ▲ (UP) arrow key to scroll through all the available channels (major and minor sub-channel)
- Depressing the ▼ (DN) arrow key permits faster tuning by 'jumping' to each major channel available from the scan.
  - o Tuning to the desired minor sub-channel is then easy by pressing the ▲ (UP) arrow key

The LCD will show the ENTRY ACCEPTED message and all TV's will briefly display a banner at the top of the screen. The banner contains the major & minor sub-channel designation and the time (time displayed comes from the broadcast stream).

INPUT STATUS:

The Input Status command screen displays valuable status information on the selected program channel.

Signal Status:

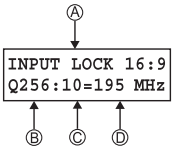
A. INPUT LOCK is indicated when a valid signal acquisition has been achieved by the DAP unit as well as the signal aspect ratio.

   NOT LOCKED will be displayed if the module fails to acquire the desired program signal.

B. INPUT SIGNAL TYPE IS DISPLAYED – such as UHF or 64/256 QAM

C. INPUT SIGNAL CHANNEL IS DISPLAYED – for example, CH 10

D. CORRESPONDING FREQUENCY FOR THE INPUT CHANNEL – 195 MHz for CH 10 CATV



DAP - Digital to Analog Processor

PICTURE SHAPE:

The DAP operator can adjust the picture shape to the desired setting for converting 16:9 images to 4:3 images as required for traditional television ratio viewing.

(The Center Cut setting is recommended in most applications)

- FULL displays the entire picture while stretching vertically to fit the screen and may present with black bars at the sides
- LETTER BOX displays the entire picture image and presents with black bars on top/bottom and left/right to fit the screen
- CENTER CUT expands the image to fit the screen while cropping some images on the left/right and presents without black bars
- ZOOM 1 has a vertical/horizontal cut with black bars
- ZOOM 2 has a vertical/horizontal cut without black bars
- SMART ZOOM 1 is a modified version of ZOOM 1 to adjust to differences in the picture shape data sent by a broadcaster

If the incoming signal is 4:3 Format, the unit will display a warning message to alert the operator that no effect will be made by changing the picture shape.

OUTPUT AUDIO:

The output volume can be adjusted within a range of 0 to 100%.

AUDIO LANGUAGE:

The AUDIO LANGUAGE command allows for the selection of an available primary or secondary audio program.

- PRIMARY ONLY – Detects only a primary audio feed.
- PRIMARY PLUS LANGUAGE – The unit will display the language name of the primary language if transmitted by the programmer, this information will not be displayed if the programmer has not included it in the PSIP data.
- SAP PLUS LANGUAGE – The unit will display the language name of the SAP language if transmitted by the programmer, this information will not be displayed if the programmer has not included it in the PSIP data.

DAP - Digital to Analog Processor

CC:EIA-608:

This is the Closed Captioning command mode. The Closed Captioning, also known as line 21 captions per EIA-608 is the standard for Closed Captioning for NTSC Broadcasts in the United States. An operator can globally enable or disable Closed Captioning for each module eliminating the need to adjust individual TV viewing locations.

OUTPUT CHANNEL MODE:

The DAP OUTPUT CHANNEL MODE can be set to standard CATV, HRC or IRC offsets as well as frequency tuning mode.

The frequency tuning mode allows a user to program a desired output frequency in 12.5 kHz steps. The unit will automatically round an improper entry to the nearest appropriate value. This mode is generally not used in typically deployments and only intended for special applications such as PAL usage.

OUTPUT LEVEL:

The RF OUTPUT LEVEL is user adjustable by pressing the ▲ (UP) or ▼ (DN) arrow buttons. The output level is not changed until the ENTER button is pressed. The level increments in 0.2 dB steps. Pressing and holding the ▲ (UP) or ▼ (DN) buttons will allow for faster scrolling. The display range is 48—62 dBmV. Output level accuracy is typically +/- 1 dB of display, +/- 2 dB worst case. Optimum SNR performance is achieved by setting the unit output @ +60 dBmV.

ANALOG RF OUTPUT:

The ANALOG RF OUTPUT is programmable by channel or frequency. Entries are made by pressing the ▲ (UP) or ▼ (DN) arrow buttons to reach the desired channel. The RF output is not changed until the ENTER button is pressed. Pressing and holding the ▲ (UP) or ▼ (DN) buttons will allow for faster scrolling. The ANALOG RF OUTPUT mode is displayed with the desired entry.

Analog Output Adjustments (Front Panel)

VIDEO LEVEL:

With the intended signal source connected and a representative video program present, turn the Video Level adjust control clockwise until the Video Overmodulation light just flashes, then back off slightly. Alternatively, while watching the picture on a good TV monitor, adjust the control to the highest (clockwise) level that does NOT cause the highlights (white portions of the picture) to become "washed out".

AUDIO LEVEL:

Turn the Audio Level adjust control clockwise until the Audio Overmodulation light just flashes slightly on the loudest peaks of the audio program material.

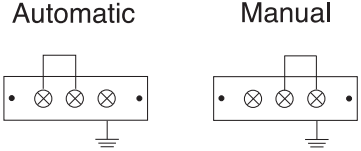
AURAL CARRIER:

To adjust the aural-to-visual carrier ratio, adjust the Aural Carrier control to obtain the desired Aural Carrier level. Recommended ratio is -15 dB.

EAS/ALT IF:

Automatic - Connect a jumper to the terminal strip auto position. EAS will become active when a +38 dBmV EAS IF signal is detected.

Manual - EAS is active with a ground connection on the manual position of the terminal strip.



DAP - Digital to Analog Processor

DAP Quick Set-Up Instruction Guide

The Quick Set-up instructions are provided as a checklist of the minimum steps required to install and program the Digital to Analog Processor.

1. Verify RF input levels
   a. Signal acquisition range is -20 to +20 dBmV — -10 to +10 dBmV is the desired optimum level
2. Program the appropriate DEMOD MODE for each module — 8VSB or QAM (Refer to page 13 for detailed variable instructions)
3. Program the appropriate CHANNEL PLAN for each module — Broadcast, Standard CATV, HRC or IRC
4. Perform a SCAN — it is not recommended to operate the unit when a scan is in process
   a. A scan must also be performed each time the DEMOD MODE is changed
5. Program the appropriate desired channel in the TUNE CHANNEL menu sequence
   a. **NOTE: A scan must be performed prior to selecting a program channel**
6. Program the appropriate desired RF Output Channel

QT - Modular QPSK/QAM Transcoder

The QT Series is a Modular QPSK to QAM Transcoder supporting up to eight QAM Transcoder Modules, interfaced with a Power & Control Module housed in a specially designed 3RU chassis.

The unit transcodes any 24-36 MHz wide QPSK modulated satellite signal to a 6 MHz wide QAM modulated IF signal and translates it to any CATV RF channel assignment in the 54-864 MHz frequency band.

The QT Series features a back-lit LCD display with front panel accessible push button controls providing access to all vital unit information, facilitating easy set-up and troubleshooting.

Interfacing the QT with Blonder Tongue's QCentral computer software provides off-site, remote operation and control including digital adjustment of the QAM RF output level.

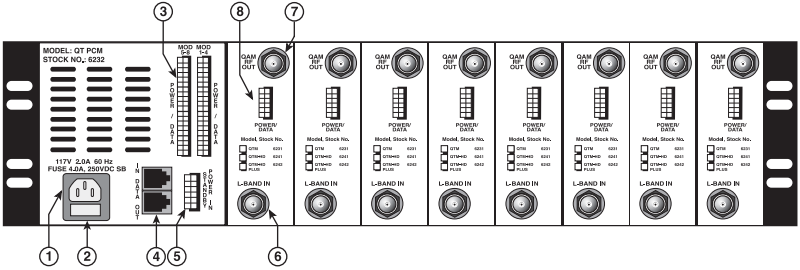
Unit Front Panel

1. **Unit Status Indicator** - Provides feedback to user based on the following LED conditions:
   a) Solid Green ON - Indicates valid QPSK and QAM lock
   b) Flash ON/OFF - QAM signal is in OFF or CW mode
   c) Flash 1x, 2x or 3x and Pause OFF - Indicates possible upconverter problem, or possible problem with power cable
   d) Flash 4x and Pause OFF - Indicates possible QAM modulator problem, check input transponder frequency and data rate to correct (check to make sure in "Auto Mode")

2. **Backlit LCD** - 8 character, 2 line Liquid Crystal Display screen used to interact with user to display unit information.

3. **Push Button Navigation Controls** - Buttons used to navigate between menus and enter unit information.

Unit Rear Panel

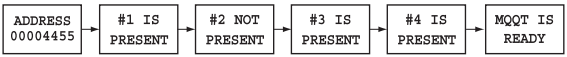


1. **Power Cord Socket** - The unit power cord plug socket.
2. **Fuse Holder** - 4.0 Amp., 250V DC, Slo Blo fuse.
3. **Module Power/Data Cables** - 2 cable sets with a 12-pin male connector used to deliver power and data to each QTM OR QTM-HD.
4. **RS232 Serial Data Ports** - Used to plug into and daisy chain QT units for remote monitoring and configuration.
5. **Power IN** - 12-pin female connector used to plug-in the optional Standby Power unit for redundant support.
6. **QPSK L-Band Input** - Independent 75 Ohm RF connector for feeding appropriate QPSK L-Band satellite input signal.
7. **QAM RF Output** - Independent 75 Ohm QAM RF Output.
8. **Power/Data** - 12-pin female connector used to plug-in cable for respective module to deliver power and data.

QPSK/QAM Transcoders

Boot-Up Display Sequence

When the unit is first plugged in for use, the control module interrogates the potential transcoder connections and displays the appropriate module condition on the LCD readout as depicted below.



Boot-Up Display Sequence

Upon completion of the boot-up sequence the transcoder is ready for use and will proceed to the loop display sequence.

CAUTION

DO NOT push any switches on the module during this sequence as it will not respond until it displays or "QTM IS READY".

Programming a Variable

Press the Left ◀ or Right ▶ arrow buttons to access the interactive variables.

1. When a user arrives at a screen that a variable needs to be changed, the user depresses and holds the ENTER button until the blinking cursor is displayed (approximately one second).
2. After the blinking cursor is displayed the user simply presses the (UP) ▲or (DN)▼arrow buttons to increment or decrement to the appropriate desired value.
3. When the user reaches the desired setting the ENTER button is pressed again to save the change. The control module then programs the corresponding transcoder module to the new information.
4. The unit displays an affirmative response after information is entered correctly. The controller will display the "Entry Accepted" response as demonstrated below.

```
ENTRY
ACCEPTED
```

5. Entries can be made to the controller for all modules, even if not all modules are installed. The controller will display module "Not Present" response if the module is not installed.

```
#2 NOT
PRESENT
```

6. The controller also displays a response to inform the user if an incorrect entry has been made, such as an entry out of the programmed range. The controller does not accept this information and forces the user to re-enter the correct information.

```
#1 OUT OF
  RANGE
```

```
RANGE IS
 2-135
```

```
RANGE IS
950-2150
```

Out of Range

QPSK/QAM Transcoders

QAM Modes

The transcoders have three QAM modes.

NORMAL: The normal QAM mode outputs a 6 MHz QAM modulated signal.

OFF: The off QAM mode outputs no signal from the module. (When a module is placed in the QAM OFF Mode, the STATUS LED indicator will blink).

CW: The CW QAM mode outputs a carrier wave test signal that is very useful for measuring the output level of the transcoder. (See the QAM Signal Level Testing section for more detail). (When a module is placed in the QAM CW Mode, the STATUS LED indicator will blink).

Additional QT Series QAM Modes.

CW ALL: Puts all QTM or QTM-HD installed in rack chassis into CW mode for ease of level adjustment.

NORMAL ALL: Puts all QTM or QTM-HD installed in rack chassis into normal QAM mode.

Output Level

The transcoders features electronic output level control for each of the single transcoder modules. The output level can be adjusted in any of the QAM modes listed above. The output level is displayed and measured as an average value. (See the QAM Signal Level Testing section for more detail).

The output level range is +30 dBmY to +40 dBmV for the QT Series. The output level will be the same for a QAM CW or EAS IF Signal as a QAM normal signal.

Note: For optimum noise performance, the output level for each module should be set nominally at the maximum output.

Factory Reset

The units have a "Factory Reset" capability built in that allows a user to erase all the current programming information for the PSCM/PCM and restore it to it's factory default setting.

To perform this function, press and hold the (UP) ▲ and (DN) ▼ arrow navigation keys simultaneously until the LCD displays "Factory Reset" and then release. This will cause the unit to reset the programmed information to the factory default setting shown on the next page.

Factory Reset

CAUTION **This will reset all programming information for all modules!**

QPSK/QAM Transcoders

The following are the default factory settings the unit will reset to:

QT Series

# 1 OUT CH 101 # 1 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	# 7 OUT CH 107 # 7 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV
# 2 OUT CH 102 # 2 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	# 8 OUT CH 108 # 8 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV
# 3 OUT CH 103 # 3 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	MODE: AUTO DECODER: DVB IN RATE: 20.000 M QAM: 128 ALPHA: 15% INTERLV: I12, J17 BD RATE: 4.761M POWER: PRIMARY
# 4 OUT CH 104 # 4 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	
# 5 OUT CH 105 # 5 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	
# 6 OUT CH 106 # 6 INPUT 974 MHz QAM: NORMAL LEVEL: 40 dBmV	

STOCK #	MODEL	FREQ. RANGE	GAIN	*GAIN RANGE	*SLOPE RANGE	NOISE FIGURE	OUTPUT LEVEL	CH. LOADING	CTB
5400-53	BIDA 550-30	47-550	33	15	10	7	36/44	77	-64
5400-55	BIDA 550-50	47-550	50	15	10	7	36/44	77	-64
5400-73	BIDA 750-30	47-750	31	15	10	9	36/44	110	-60
5400-##	BIDA SERIES	5-30	24	12	12	6	42	2	-60
5800-53	BIDA-55A-30	49-550	32	10	8	7.0	36/44	77	-64
5800P53	BIDA-55A-30P	49-550	32	10	8	7.0	36/44	77	-71
5800-54	BIDA-55A-43	49-550	43	10	8	7.0	36/44	77	-63
5800P54	BIDA-55A-43P	49-550	43	10	8	7.0	36/44	77	-68
5800-55	BIDA-55A-50	49-550	50	10	8	7.5	36/44	77	-63
5800-73	BIDA-75A-30	49-750	32	10	8	8.5	36/44	110	-60
5800P73	BIDA-75A-30P	49-750	32	10	8	8.5	36/44	110	-64
5800-74	BIDA-75A-43	49-750	43	10	8	8.5	36/44	110	-56
5800P74	BIDA-75A-43P	49-750	43	10	8	8.5	36/44	110	-64
5800-83	BIDA-86A-30	49-860	32	10	8	8.5	36/44	129	-54
5800P83	BIDA-86A-30P	49-860	32	10	8	8.5	36/44	129	-62
5800-84	BIDA-86A-43	49-860	44	10	8	8.5	36/44	129	-56
5800P84	BIDA-86A-43P	49-860	43	10	8	7.0	36/44	129	-60
5800-13	BIDA-100A-30	49-1000	32	10	8	8.5	36/44	150	-59
5800-##	BIDA SERIES	5-36	20	18	NA	6.0	42	3	-60
5818	LPA-860-36G	53-860	36	FIXED - PLUG-INS		7	36/46	79	-80
	LPA-860-36G	5-42	18.5	FIXED - PLUG-INS		6	40	4	-87

* Specifications do not include optional plug-in attenuators and equalizers.
* CTB distortion measured at listed output level and channel loading.

Directional Couplers Insertion Loss

Indoor

STOCK #	TAP VALUE (dB)	NO. OF OUTPUTS	THRU-LINE LOSS (dB)	
SRT-1			@450 MHz	@1000 MHz
1940-4	4	1	4.0	4.5
1940-6	6		3.5	4.0
1940-9	9		1.6	2.0
1940-12	12		1.5	2.0
1940-16	16		0.7	1.5
1940-20	20		0.7	1.5
1940-24	24		0.6	1.5
1940-27	27		0.6	1.5
1940-30	30		0.6	1.5
SRT-2A			@450 MHz	@1000 MHz
1942-4	4	2	Terminated	
1942-8	8		3.2	3.5
1942-11	11		2.5	3.0
1942-14	14		1.2	2.2
1942-17	17		1.0	1.8
1942-20	20		0.9	1.2
1942-23	23		0.9	1.2
1942-26	26		0.7	1.2
1942-29	29		0.7	1.2
1942-32	32		0.7	1.2
SRT-4A			@450 MHz	@1000 MHz
1944-8	8	4	Terminated	
1944-11	11		3.8	4.4
1944-14	14		2.3	2.5
1944-17	17		1.5	2.0
1944-20	20		1.2	1.4
1944-23	23		1.0	1.2
1944-26	26		0.9	1.0
1944-29	29		0.8	1.0
1944-32	32		0.8	1.0
1944-35	35		0.8	1.0
SRT-8A			@450 MHz	@1000 MHz
1948-11	11	8	Terminated	
1948-14	14		3.8	4.3
1948-17	17		2.1	2.3
1948-20	20		1.3	1.8
1948-23	23		0.8	1.2
1948-26	26		0.7	1.0
1948-29	29		0.6	0.8
1948-32	32		0.6	0.8
1948-35	35		0.6	0.8

Outdoor

MODEL STOCK NO.	TAP VALUE (dB)	THRU-LINE LOSS (dB)	
		@450 MHz	@1000 MHz
DMT-1000-2 #3852	4	Terminated	
	8	4.1	4.8
	11	2.2	3.7
	14	1.7	2.4
	17	1.4	2.2
	20	1.0	1.5
	23	1.0	1.5
	26	1.0	1.5
	29	1.0	1.5
	32	1.0	1.5
	35	1.0	1.5
DMT-1000-4 #3854	8	Terminated	
	11	4.0	4.9
	14	2.2	3.7
	17	1.6	2.2
	20	1.3	2.0
	23	1.2	1.8
	26	1.0	1.5
	29	1.1	1.5
	32	1.2	1.5
	35	1.2	1.5
DMT-1000-8 #3858	11	Terminated	
	14	4.2	4.9
	17	2.4	3.5
	20	1.7	2.6
	23	1.3	2.2
	26	1.2	1.5
	29	1.2	1.5
	32	1.2	1.5
	35	1.2	1.5

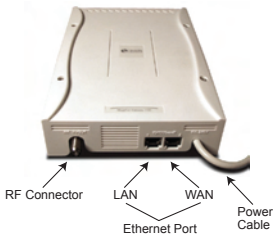
MODEL STOCK NO.	TAP VALUE (dB)	THRU-LINE LOSS (dB)	
		@450 MHz	@1000 MHz
TL-PI-1000 #3850	N/A	1.2	1.5
TLS-1000 #3851	8	2.9	3.2
	12	1.2	2.2
	16	1.2	2.2
TLS-1000-2 #3855	N/A	4.6	5.7
TLS-1000-3 #3856	N/A	7.0	9.0
TLS-1000-3U #3857 (unbalanced)	N/A	5.0/8.5	6.0/9.2

Please refer to the Blonder Tongue catalog for more detailed specifications common to indoor and outdoor passives.

MegaPort Components

MegaPort Gateway (MPG)

This is the interface between the trunk data network and the coax. Each MPG supports up to 64 MPOs and is connected at the coax's point of entry to the building, community, campus or individual home.



The connection to the LAN Port will be made directly with a cross cable via MegaPort manager or http web interface.

The Port ID is: 172.16.70.1 C Class

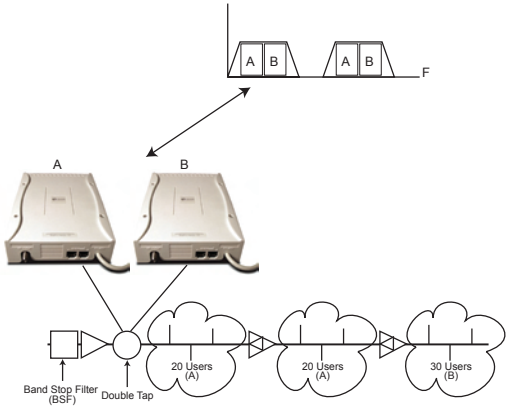
MegaPort Intelligent Outlet (MPO)

Replacing ordinary TV outlets, the IO is connected to the coax infrastructure providing TV and network connections(10BaseT & USB). An MPO may be installed complementary to an existing outlet for ease of installation.

MegaPort Methods of Installation

Case Study

The diagram below is an example of multiple users situated between amplifiers.



Upstream and Downstream Signal Settings

Frequency Diversity

Frequency Diversity is when each MPG DS and US carrier are set at a different frequency. This is typically used when multiple MPG's are on the same cable leg.

Frequency Re-Use

Frequency Re-Use is when each MPG DS and US carrier are set at the same frequency. This can only occur when MPG's are not on the same cable leg.

MegaPort Software Utilities - ConfigIO

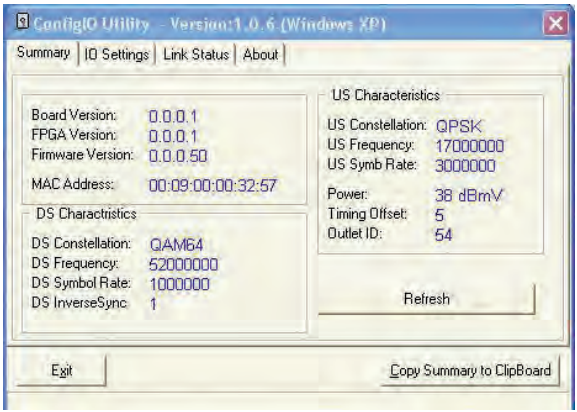
ConfigIO Utility Software

ConfigIO is an application designed to let the technician see the link stat settings.

There is a protocol that needs to be installed in the connection properties.

Ethernet - TMT Management Protocol Driver

USB - Ndisuio.inf protocol

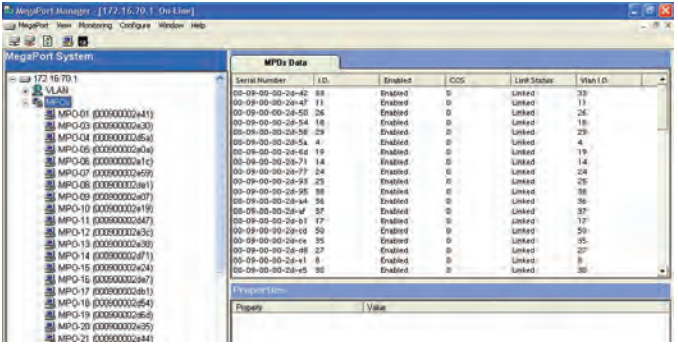


In order to see data of the IO/MPO components, go to the 'Summary' tab. You can see the version of the IO hardware and software, the IO MAC address (or- serial number), its ID and other parameters as shown in the screenshot.

For more information please refer to the User's Manual.

MegaPort Manager

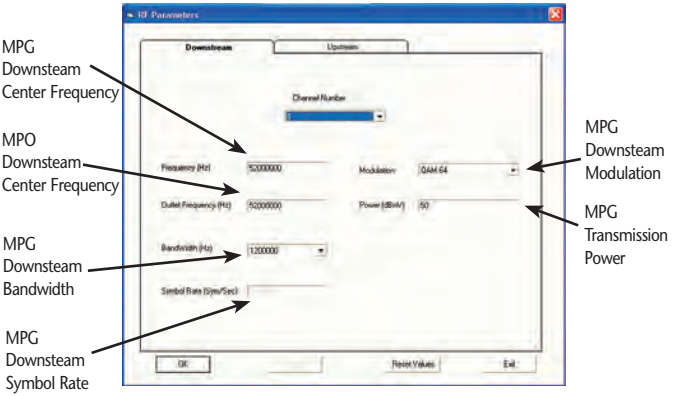
MegaPort Manager Main Screen - with MPO's installed.



Note: Visit the Blonder Tongue FTP Site for the latest software releases and updates at ftp://ftp1.blondertongue.com

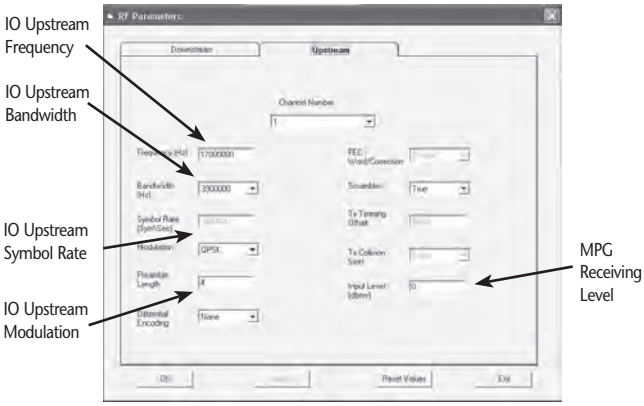
MegaPort Manager - RF Data

In order to adjust an RF parameter, open the “Configure MPG” dialog box. You can do that by double-clicking the “MPG” node, or by pressing Ctrl+B. Click the Downstream or Upstream tab.



Note: If DS parameter is being changed you have to change the same parameter manually in every IO with the ConfigIO software.

MegaPort Manager



Note: If US parameter is being changed the change will take effect for the IO automatically.

MegaPort Manager - Tips

By clicking on the column header of the detail pane, the user can sort in ascending or descending order.

To add remove columns, you can either right-click the columns header or click on the 'View' menu, and then choose 'Customize Current View…'.

To change column order, you can either use 'drag and drop' and move the header left/right, or use the form opened by 'Customize Current View…', mark the field you want to change, and press 'Move Up' or 'Move Down'.

IMPORTANT! If the message box 'Request Timed Out' appears often, it could mean that the SNMP Session parameters 'Time Out' or 'No. of Retries' are too low.

You can change this in the 'Application Setting' form, which can be opened from the View-> Settings menu or using Ctrl + T.

F5 and the 'Refresh' toolbar button don't refresh all data presented in the main window. They refresh only data that are likely to change, such as counters. To make a full refresh, you must click on the 'View' menu, and choose 'Refresh All'.

If some IOs or Users were deleted by someone else after you connected to a specific MPG the application will not update these changes even if a full refresh is done. You have to disconnect from the MPG, and then reconnect to it, and then the new configuration window will be updated.

MegaPort Manager - Troubleshooting

How to verify that the IO is working properly

Important: All these steps are related to a MPG that has other MPO's that are working properly

Connect the PC to the MPO and the ping the RF port of the MPG @ 192.168.0.1. No response, go to #1.

1. Ensure the MPO MAC is defined in the system using the MegaPort Manager Software.
2. Open the ConfigIO and verify a green light in the link status. If the light is red press the summary tab and observe if the IO parameters are matching this MPG, If it matches, check for DS RF problem.
3. Check the RF cable connection- check the cable is connected properly.
4. Press the Monitor RF status tab and observe if the upstream power is stable. If it is not stable check for US RF problem
5. On the PC, observe that the IO-NETWORK-DEVICE receives an IP from the DHCP server. Open a DOS window type "ipconfig/release" and then "ipconfig/renew".
6. In the ConfigIO software, go to IO settings, click the "Automatic US Power "(Uncheck the box √) Enter 10 at the "Static US Power Value", and click set.
7. Click the "Automatic US Power " (Uncheck the box √ again) and click set, observe if the upstream power is stable. If it is not stable continue to number 8. Open a DOS window, type "ipconfig/release" and then "ipconfig/renew".
8. Connect this IO to another PC.
9. Connect this IO at another known good location that has been tested with a PC.

Addressable Products

Addressable off-premise interdiction can be used in a total deployment where all homes are controlled by interdiction, or a limited deployment where a subset of homes are controlled. The "interdiction" terminology comes from the fact that the interfering or jamming signal is introduced into the premium channel at the subscriber's location, not at the headend as with conventional scrambling systems.

There are four addressable product lines:

- VideoMask™ Interdiction (VMI)
- TV Channel Blocker (TVCB)
- TV Channel Blocker Parental Controlled (TVCB-PC)
- Subscriber Module Interdiction (SMI)
  (Formerly known as Scientific Atlanta addressable interdiction system.)
- Addressable Multi-Port Tap Interdiction Unit (AMT)

For each product line, the following information is provided:

1. System Design
2. Installation
3. Troubleshooting

For additional information from previous Reference Guide versions, please visit our website: www.blondertongue.com

Jamming Capability

Each Addressable Field Unit consists of various oscillator configurations that are used to generate the jamming signals. Each oscillator may be shared among multiple channels within a set band of frequencies. The VMI, SMI and TVCB oscillator configurations are shown below for example.

VMI System Design

VMI Directional Coupler (DC) Table

0, 4, 8, 11, 14, 17 dB								
Insertion Loss	0	4	6	8	11	14	17	
5 MHz:	NA	4.0	3.0	2.1	1.3	1.7	1.1	dB
54 MHz:	NA	3.3	2.9	1.2	0.8	.08	.06	dB
550 MHz:	NA	4.3	4.2	2.3	1.4	1.3	1.0	dB
750 MHz:	NA	4.8	4.5	2.7	1.7	1.7	1.1	dB
860 MHz:	NA	4.7	4.5	2.9	2.0	1.8	1.4	dB

VMI Equalizer (EQ) Table

VMI-CEQ8V 860 MHz Equalizers					
EQ Value	Tilt Comp @ 860 MHz	Loss @ 54 MHz	Loss @ 550 MHz	Loss @ 750 MHz	Loss @ 860 MHz
-4	-2.56	-1.12	-2.37	-3.19	-3.68
-3	-1.87	-0.97	-1.96	-2.50	-2.84
-2	-1.23	-0.65	-1.15	-1.54	-1.88
-1	-0.87	-0.03	-0.31	-0.67	-0.90
0	0.00	0.00	0.00	0.00	0.00
1	1.07	-1.52	-1.23	-0.60	-0.46
2	1.89	-2.23	-1.24	-0.16	-0.35
3	2.88	-3.05	-1.38	-0.10	-0.17
4	3.47	-3.81	-2.01	-0.79	-0.35
5	3.86	-4.35	-2.13	-0.94	-0.49
6	4.45	-4.85	-2.32	-0.80	-0.40
7	5.42	-5.67	-2.42	-0.62	-0.25
8	5.99	-6.37	-2.00	-0.79	-0.38
9	7.08	-7.21	-2.68	-0.68	-0.13
10	7.47	-7.89	-2.94	-0.90	-0.43
11	8.21	-8.55	-3.24	-0.96	-0.34
12	9.01	-9.25	-1.60	-0.51	-0.24
13	9.85	-10.27	-4.00	-1.32	-0.42
14	10.76	-10.89	-1.37	-0.36	-0.14
15	11.18	-11.30	-1.40	-0.36	-0.13
16	12.04	-12.29	-1.63	-0.55	-0.25
17	12.69	-12.87	-1.50	-0.48	-0.18
18	13.64	-13.84	-1.86	-0.56	-0.20
19	14.36	-14.52	-1.75	-0.50	-0.16
20	14.94	-15.15	-1.92	-0.58	-0.21

Note: For additional design information, see the 2000 CATV Reference Guide found on our website: www.blondertongue.com

VMI System Design

VMI Power Consumption

	Current Consumption (mA)		
Volts (VAC)	1 Jammer Module	w/2 Jammer Modules	w/3 Jammer Modules
45.00	325	410	515
50.00	330	375	465
55.00	310	355	420
60.00	295	360	390
65.00	240	315	385
70.00	230	300	360
75.00	220	285	340
80.00	205	265	325
85.00	195	255	310
90.00	190	245	295

VMI Installation

Power Supply Pinout

Pin#	7	6	5	4	3	2	1
Voltage	28 VDC	NOT USED	12 VDC	GND	6.2 VDC	GND	60 VAC
Minimum	26.0		11.4		6.1		45
Maximum	30.0		12.6		6.3		60

Insertion Loss Specifications for Equalizers (EQ)

VMI-CEQ8V 860 MHz Equalizers					
EQ Value	Tilt Comp @ 860 MHz	Loss @ 54 MHz	Loss @ 550 MHz	Loss @ 750 MHz	Loss @ 860 MHz
-4	-2.56	-1.12	-2.37	-3.19	-3.68
-3	-1.87	-0.97	-1.96	-2.50	-2.84
-2	-1.23	-0.65	-1.15	-1.54	-1.88
-1	-0.87	-0.03	-0.31	-0.67	-0.90
0	0.00	0.00	0.00	0.00	0.00
1	1.07	-1.52	-1.23	-0.60	-0.46
2	1.89	-2.23	-1.24	-0.16	-0.35
3	2.88	-3.05	-1.38	-0.10	-0.17
4	3.47	-3.81	-2.01	-0.79	-0.35
5	3.86	-4.35	-2.13	-0.94	-0.49
6	4.45	-4.85	-2.32	-0.80	-0.40
7	5.42	-5.67	-2.42	-0.62	-0.25
8	5.99	-6.37	-2.00	-0.79	-0.38
9	7.08	-7.21	-2.68	-0.68	-0.13
10	7.47	-7.89	-2.94	-0.90	-0.43
11	8.21	-8.55	-3.24	-0.96	-0.34
12	9.01	-9.25	-1.60	-0.51	-0.24
13	9.85	-10.27	-4.00	-1.32	-0.42
14	10.76	-10.89	-1.37	-0.36	-0.14
15	11.18	-11.30	-1.40	-0.36	-0.13
16	12.04	-12.29	-1.63	-0.55	-0.25
17	12.69	-12.87	-1.50	-0.48	-0.18
18	13.64	-13.84	-1.86	-0.56	-0.20
19	14.36	-14.52	-1.75	-0.50	-0.16
20	14.94	-15.15	-1.92	-0.58	-0.21

Note: For the EQ Loss table @ 750 MHz, please visit our website: www.blondertongue.com

TVCB Systems Design

Power Consumption

The TVCB can be powered a number of ways:

1. House powered via 120VAC outlet:
   Power consumption 11.8W @ 24VAC (550 mA)

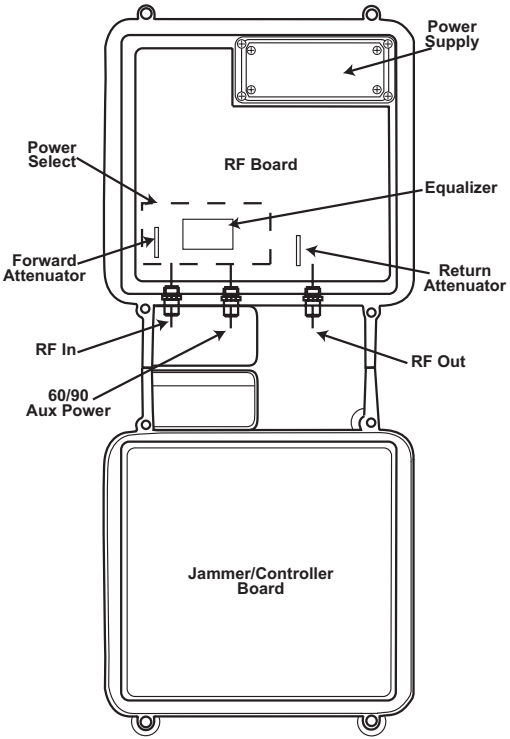
2. Auxiliary or Line Powered:
   Power consumption 8.0W @ 60VAC (200 mA)
   8.8W @ 90VAC (150 mA)

Below are the power consumptions of the TVCB:

Volts	Curr.	Watts
24.00	580 mA	11.8
60.00	200 mA	8.0
90.00	150 mA	8.8

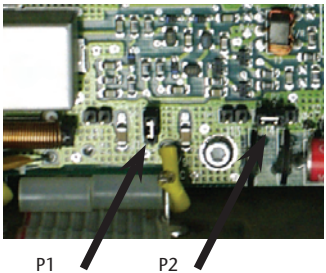
TVCB Systems Design

Power Selection

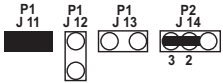


TVCB Installation

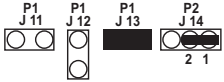
Power Selection



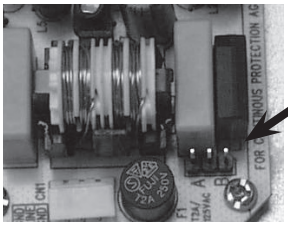
Feeder Power



House Power



Auxillary Power



Position A

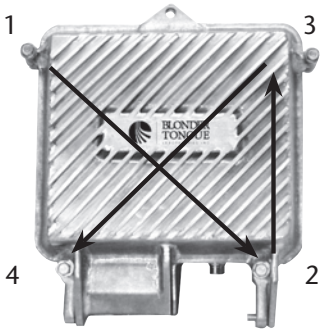
60/90 VAC
Network Powering

Position B

26 VAC
House Powering

TVCB Installation

Tightening Sequence



Tightening:

Use a criss-cross pattern to tighten the housing bolts.

Tighten closure bolts between 5-7 ft. lbs.

TVCB Troubleshooting

Fault Action - Pulse Disconnect

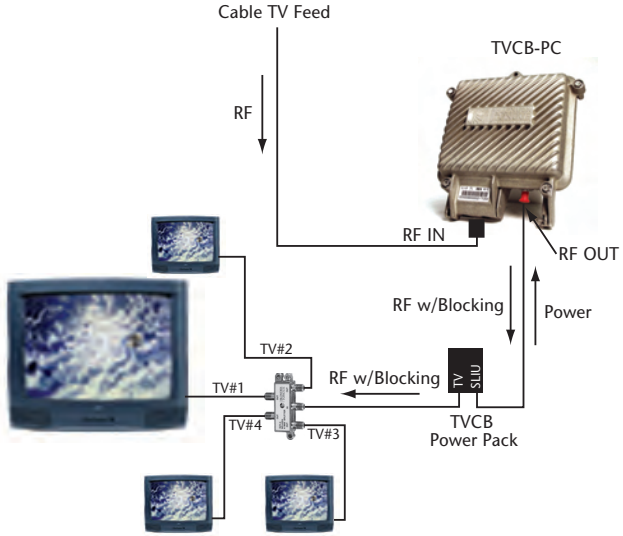
Pulse Disconnect has the following codes to identify which fault has occurred:

- Tamper 1 Flash of Disconnect
- Unit Time Out 2 Flashes of Disconnect
- Unit Address 3 Flashes of Disconnect
- Calibration 4 Flashes of Disconnect
- EEPROM 5 Flashes of Disconnect

TVCB-PC (Parental Controlled) System Design

TV Channel Blocker Parental Controlled (TVCB-PC) enables cable television customers to block unwanted channels when they presently lack the equipment necessary to prevent unwanted channels from being viewed.

The TVCB-PC provides channel blocking (ch. 2-86) to all televisions in the dwelling. The TVCB-PC is a stand alone unit that has push button control inside, that allows you to change blocked channels quickly and easily without cable company reprogramming.



Note: The TVCB-PC Self Install/Consumer (#9111) is an end user ready unit conditioned for home installaton and does not require measurment of RF input levels or adjustments to EQ or AT's.

TVCB-PC Installation

1. Determine mounting location, install screws for wall mounting bracket
2. Determine power source location and power supply option, position P1 appropriately
3. Power the unit, from RF Input, Subscriber Port, or Auxiliary Port (default from the factory)
4. Measure RF Input Levels at the tap port of the external Directional Coupler (Channels 2 & 78)

Note: When measuring input levels, check adjacent channels for response flatness, use the highest value when selecting plug-in values

Minimum Input Requirements

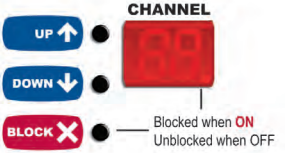
- 9.0 dBmV @ 54 MHz (Ch. 2)
- 15.0 dBmV @ 550 MHz (Ch. 78) 5. If required for application, select Attenuator (AT) & Equalizer (EQ) from chart

5. Items 6 - 9 are not required for the 9111

For 9110 Only		For 9110 Only
	6. Plug-in appropriate EQ and Fwd AT	
	7. Verify AGC Voltage 3.1 VDC optimum; 3.0 – 3.2 VDC acceptable	
	8. Verify unit RF Output Levels **Subscriber Port Output** • 10.0 dBmV @ 54 MHz (Ch. 2) • 16.0 dBmV @ 600 MHz (Ch. 78)	
	9. Adjust EQ and AT (if necessary)	
	10. Select Parental Controlled Channels to be Blocked (do not block more than 4 channels sequentially)	
	11. Verify blocked and unblocked channels at output port	
	12. Educate the customer on how to change blocked channels on the unit, leave customer pamphlet	

CHANNEL BLOCKER
Parental Controlled

For more information, visit
www.TVChannelBlocker.com



To Block / Unblock Channels

Use the UP and DOWN buttons to find the channels you wish to block.

Press the BLOCK button to block or unblock channels.

The **RED DOT** next to the channel number indicates that the channel is blocked.

To Turn OFF / ON Viewing

Press **both** the UP and DOWN buttons simultaneously for a count of five (5) seconds to totally turn viewing off or on for all channels.

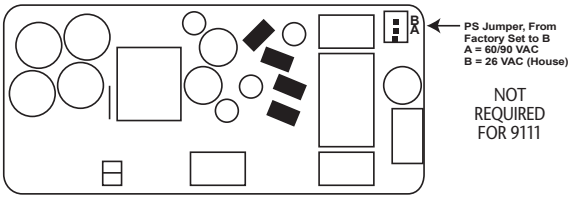
TVCB-PC Installation

Power Selection - 9110

The TVCB-PC can be powered from the RF Input, Subscriber Port, or Auxiliary Port (default). The unit is configured for HOUSE POWER from the factory.

Power Supply Voltages & Power Selection

Use Jumper located on the power supply board to select between 26 or 60/90 VAC input.



Power Supply Jumper Determines Voltage

Automatic Gain Control

Broadband AGC using carriers in 140 - 240 MHz range with dynamic range of ±3 dB.

TVCB-PC Troubleshooting

In case of failure, the small round LED may flash 4 times.

Please refer to the Instruction Manual for further information

750 MHz Directional Coupler (DC) Insertion Loss

Tap Loss DC Value	Stock #	DC Feeder (through) Insertion Loss				
		Reverse Path		Forward Path		
		5 MHz	40 MHz	51 MHz	550 MHz	750 MHz
0.0	291659	Terminating		Terminating		
1.0	291611	Terminating		Terminating		
2.0	378224	Terminating		Terminating		
3.0	378225	Terminating		Terminating		
4.0	562958	2.5	2.5	3.5	3.9	4.2
5.0	562959	2.4	2.4	3.5	3.9	4.2
6.0	562960	2.3	1.8	2.1	2.4	2.7
7.5	562961	2.3	1.8	2.1	2.5	2.7
9.0	562962	2.1	1.4	1.4	2.1	2.4
10.5	562963	2.1	1.4	1.4	2.1	2.4
12.0	562964	1.4	1.0	0.8	1.3	1.7
13.5	562965	1.4	1.0	0.8	1.3	1.7
15.0	562966	1.2	0.8	0.8	1.3	1.7
16.5	562967	1.2	0.8	0.7	1.1	1.4
18.0	562968	1.3	0.8	0.7	1.1	1.4
19.5	562969	1.3	0.8	0.7	1.1	1.4
21.0	562970	1.3	0.8	0.7	1.1	1.4
22.5	562971	1.3	0.8	0.7	1.1	1.4
24.0	562972	1.3	0.8	0.7	1.1	1.4
25.5	562973	1.3	0.8	0.7	1.1	1.4
27.0	562974	1.3	0.8	0.7	1.1	1.4
28.5	562975	1.3	0.8	0.7	1.1	1.4
30.0	562976	1.3	0.8	0.7	1.1	1.4
31.5	562977	1.3	0.8	0.7	1.1	1.4

SMI System Design

(DC) Coupled Port Loss

Tap Loss		DC Coupled Port Loss*				
		Reverse Path		Forward Path		
DC Value	Stock #	5 MHz	40 MHz	51 MHz	550 MHz	750 MHz
0.0	291659	0.3	0.8	0.7	0.7	0.7
1.0	291611	0.8	1.3	1.7	1.7	1.7
2.0	378224	1.8	2.3	2.7	2.7	2.7
3.0	378225	2.8	3.3	3.7	3.7	3.7
4.0	562958	8.2	6.1	5.4	5.2	5.3
5.0	562959	8.8	7.0	6.3	6.4	6.7
6.0	562960	6.7	7.5	7.0	7.4	9.8
7.5	562961	7.7	8.4	8.0	8.3	10.6
9.0	562962	9.5	10.5	10.2	9.3	9.4
10.5	562963	0.4	11.3	11.1	10.0	9.9
12.0	562964	12.0	12.8	12.7	11.1	11.6
13.5	562965	13.5	14.3	14.2	12.3	12.2
15.0	562966	15.0	15.7	15.6	13.3	13.4
16.5	562967	16.4	17.1	17.0	14.8	14.6
18.0	562968	17.8	18.4	18.4	15.1	14.3
19.5	562969	19.6	20.2	20.2	16.4	15.6
21.0	562970	20.9	21.4	21.4	17.1	15.9
22.5	562971	22.3	22.9	22.9	18.3	16.9
24.0	562972	23.9	24.5	24.5	19.5	17.8
25.5	562973	25.5	26.1	26.2	21.5	20.3
27.0	562974	26.8	27.4	27.4	22.1	20.5
28.5	562975	28.3	28.8	29.0	22.8	20.4
30.0	562976	29.8	30.3	30.5	23.4	20.5
31.5	562977	30.9	31.3	31.6	23.7	20.4

* All forward and reverse DC coupled port losses include the additional loss of the duplex filter.

750 MHz Equalizer Insertion Loss

EQ Value	Stock #	51 MHz	550 MHz	750 MHz
-9.0	562996	2.7	9.1	10.4
-7.5	562995	1.9	7.5	8.5
-6.0	562994	1.4	5.9	6.2
-4.5	562993	1.6	4.4	4.8
-3.0	562992	0.1	2.7	3.0
-1.5	562991	0.1	1.3	1.5
0.0	566057	0.1	0.1	0.2
1.5	562978	1.9	1.2	0.9
3.0	562979	2.9	1.3	0.8
4.5	562980	4.1	1.5	0.8
6.0	562981	5.4	1.8	0.9
7.5	562982	6.5	1.9	0.7
9.0	562983	7.5	2.1	0.7
10.5	562984	8.8	2.5	0.9
12.0	562985	10.0	2.9	1.0
13.5	562986	11.4	3.4	1.3
15.0	562987	12.2	3.3	0.9
16.5	562988	13.6	3.8	1.0
18.0	562989	14.7	3.8	0.8
19.5	562990	15.6	4.0	0.9

SMI System Design

4-Port Power Consumption *

	Housing Only		w/2 Module		w/4 Modules	
Volts	**Current**	**Watts**	**Current**	**Watts**	**Current**	**Watts**
35.00	0.09	2.35	0.26	7.74	0.50	14.74
40.00	0.08	2.45	0.23	7.85	0.43	14.25
45.00	0.08	2.56	0.20	7.95	0.37	13.76
50.00	0.07	2.64	0.19	7.99	0.33	13.60
55.00	0.07	2.73	0.18	8.02	0.30	13.44
60.00	0.07	2.88	0.17	8.04	0.28	13.30
65.00	0.06	3.04	0.16	8.06	0.26	13.17
70.00	0.06	3.04	0.15	8.25	0.24	13.43
75.00	0.06	3.04	0.15	8.44	0.23	13.69
80.00	0.07	3.15	0.14	8.52	0.22	13.81
85.00	0.07	3.25	0.14	8.61	0.21	13.94
90.00	0.07	3.36	0.13	8.69	0.21	14.07

*Measurements are adjusted to compensate for changes over temperature.

SMI System Design

8-Port Power Consumption *

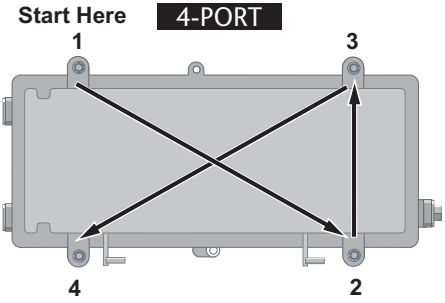
	Housing Only		w/2 Module		w/4 Modules	
Volts	**Current**	**Watts**	**Current**	**Watts**	**Current**	**Watts**
35.00	0.18	5.25	0.36	10.33	0.57	16.74
40.00	0.17	5.20	0.32	10.36	0.50	16.24
45.00	0.15	5.15	0.28	10.40	0.43	15.75
50.00	0.14	5.27	0.26	10.50	0.50	18.80
55.00	0.13	5.40	0.25	10.61	0.36	15.65
60.00	0.13	5.48	0.23	10.71	0.34	15.77
65.00	0.13	5.57	0.22	10.82	0.32	15.90
70.00	0.13	5.85	0.22	11.08	0.30	16.03
75.00	0.13	6.13	0.21	11.34	0.29	16.17
80.00	0.13	6.44	0.21	11.66	0.28	16.31
85.00	0.13	6.76	0.21	11.98	0.26	16.45
90.00	0.13	7.08	0.20	12.31	0.25	16.59

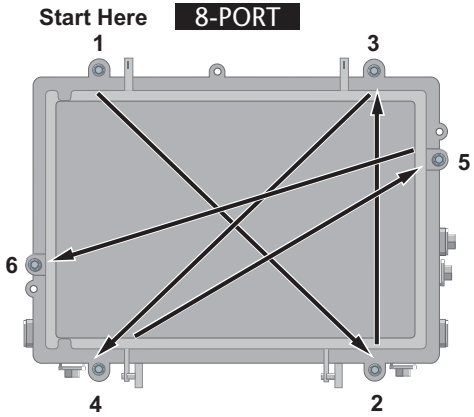
	w/6 Modules		w/8 Modules	
Volts	**Current**	**Watts**	**Current**	**Watts**
35.00	0.80	22.58	0.97	28.81
40.00	0.71	22.39	0.84	27.96
45.00	0.62	22.20	0.71	27.11
50.00	0.57	22.02	0.65	26.84
55.00	0.52	21.84	0.59	26.57
60.00	0.48	21.68	0.55	26.81
65.00	0.45	21.53	0.51	27.05
70.00	0.44	21.70	0.49	27.02
75.00	0.43	21.88	0.47	26.99
80.00	0.41	22.09	0.45	27.21
85.00	0.39	22.30	0.44	27.43
90.00	0.37	22.51	0.43	27.66

* Measurements are adjusted to compensate for changes over temperature.

SMI Installation

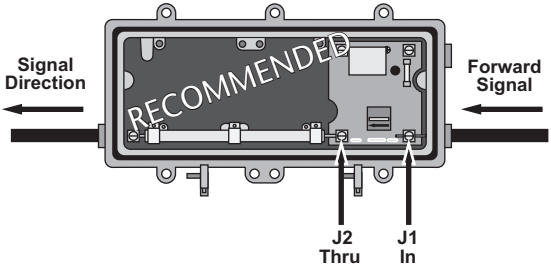
Torque Patterns



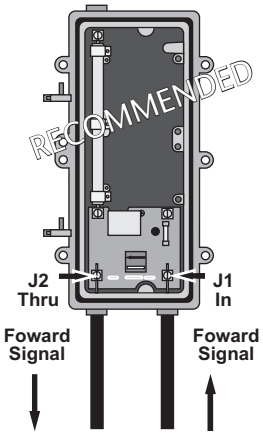


SMI Installation

Strand Mount (4-port) Configurations



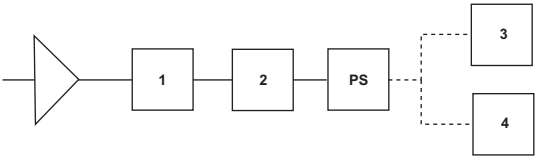
Pedestal Mount (4-port) Configurations



SMI Installation

Balancing and Alignment

The SMI unit has a series of jumpers whose position is determined by the RF and AC status of the unit. The selection of DC determines the RF status: values 0, 1, 2, or 3 dB are terminating and the remaining DCs (4-31.5 dB) are non-terminating DC's.



	Scenario 1	Scenario 2	Scenario 3	Scenario 4
DC Value	4-31.5 dB	4-31.5 dB	4-31.5 dB	0, 1, 2, 3 dB
AC Termination	No	Yes	Yes	Yes
RF Termination	No	No	Yes - Add 75 Ohm Term	Yes - DC Term
Input Seizure Block	J1 or J2	J1 Only	J1 Only	J1 Only
Jumper Configuration	P1 - Leave	P1 - Leave	P1 - Leave	P1 - Pull
	P2 - Leave	P2 - Pull	P2 - Leave	P2 - Leave
	P5 - Discard	P5 - Discard	P5 - Discard	P5 - Install Term Board

SMI Installation

Passing Power to the Home

Some 750 MHz SMI units and subscriber modules are capable of passing 37-90 VAC power to each subscriber port. This capability provides power to a telephony or data network interface unit (NIU)/customer interface unit (CIU).

- If a CIU is not in the home: Make sure during installation that power is not present at the subscriber port. Use the proper 750 MHz housing/power supply/subscriber module combination so as not to pass power.
- If a CIU is in the home: Power passes from the subscriber port to the CIU, so install the optional power passing jumper P/N 568839 in the direction indicated on the subscriber module P/N 564265.

Passing Power to Unused Feeder Ports

If 750 MHz housing is equipped with a...	You can use...
non-power passing power supply	any subscriber module.
power passing power supply	P/N 564265 (without optional power passing jumper installed), or P/N 566024 (no power passing capability).

CAUTION

If no CIU is present at the subscriber drop, do not install a power passing subscriber module in a 750 MHz housing equipped with a power passing power supply or severe damage to the subscribers TV or VCR may result.

SMI Troubleshooting

Diagnostics

The SMI unit has factory default parameters that immediately activate all ports upon initial installation. There are no jamming frequencies assigned at the factory. This allows the full spectrum of channels to pass, "in the clear," to the subscriber drop port once you install a sub module.

- Tamper 1 Flash
- Refresh Timer 2 Flashes
- VCO Failure 4 Flashes

LGTC Directional Couplers, Insertion Loss

Frequency	LTC0	LTC4	LTC7	LTC10	LTC13	LTC16	LTC19	LTC22	LTC25
AVE									
5	N/A	3.75	1.67	1.19	0.80	0.93	0.60	0.60	0.60
10	N/A	3.65	1.68	1.25	0.85	1.02	0.65	0.65	0.65
30	N/A	3.45	1.48	1.02	0.66	0.75	0.50	0.50	0.50
40	N/A	3.45	1.49	1.02	0.67	0.75	0.50	0.50	0.50
50	N/A	3.45	1.50	1.01	0.67	0.75	0.50	0.50	0.50
100	N/A	3.55	1.58	1.06	0.73	0.80	0.55	0.06	0.55
300	N/A	3.91	1.85	1.23	0.88	0.93	0.70	0.70	0.70
450	N/A	4.08	2.05	1.35	0.98	1.02	0.80	0.80	0.80
550	N/A	4.15	2.19	1.42	1.04	1.08	0.87	0.87	0.87
650	N/A	4.20	2.32	1.51	1.12	1.15	0.95	0.95	0.95
750	N/A	4.23	2.43	1.60	1.20	1.22	1.05	1.05	1.05
860	N/A	4.26	2.54	1.72	1.31	1.30	1.15	1.15	1.15
1000	N/A	4.30	2.68	1.90	1.45	1.40	1.30	1.30	1.30
MAX									
5	N/A	4.00	1.90	1.40	1.10	1.20	0.85	0.85	0.85
10	N/A	3.80	1.90	1.40	1.10	1.20	0.90	0.90	0.90
30	N/A	3.75	1.85	1.20	0.90	1.00	0.70	0.70	0.70
40	N/A	3.75	1.80	1.20	0.90	1.00	0.70	0.70	0.70
50	N/A	3.75	1.80	1.20	0.90	1.00	0.70	0.70	0.70
100	N/A	3.80	1.80	1.25	0.90	1.00	0.70	0.70	0.70
300	N/A	4.10	2.10	1.45	1.07	1.15	0.85	0.85	0.85
450	N/A	4.30	2.35	1.60	1.20	1.25	1.00	1.00	1.00
550	N/A	4.40	2.50	1.70	1.29	1.33	1.10	1.10	1.10
650	N/A	4.50	2.65	1.80	1.38	1.42	1.20	1.20	1.20
750	N/A	4.53	2.80	1.90	1.47	1.50	1.30	1.30	1.30
860	N/A	4.65	2.95	2.03	1.58	1.60	1.40	1.40	1.40
1000	N/A	4.70	3.15	2.20	1.70	1.70	1.55	1.55	1.55

AMT System Design

LGT 8-Port Tap Losses

Frequency	LTC0	LTC4	LTC7	LTC10	LTC13	LTC16	LTC19	LTC22	LTC25
AVE									
5	10.1	13.2	17.4	19.9	22.8	26.2	29.4	32.5	35.5
10	10.1	13.2	17.4	19.9	22.8	26.2	29.4	32.5	35.4
30	10.0	13.2	17.3	19.7	22.7	26.0	29.3	32.4	35.3
40	10.0	13.2	17.3	19.7	22.7	26.0	29.2	32.3	35.2
50	10.0	13.2	17.3	19.7	22.7	26.0	29.2	32.3	35.2
100	10.0	13.3	17.3	19.8	22.8	26.1	29.3	32.4	35.3
300	10.5	13.6	17.6	20.1	23.2	26.3	29.5	32.5	35.4
450	10.8	14.0	17.8	20.2	23.3	26.5	29.5	32.4	35.6
550	11.1	14.3	17.9	20.3	23.4	26.5	29.5	32.3	35.5
650	11.3	14.7	18.3	20.5	23.7	26.8	29.7	32.5	35.8
750	11.6	15.1	18.9	20.9	24.1	27.2	30.1	33.1	36.5
860	11.9	15.5	19.5	21.2	24.5	27.6	30.5	33.8	37.4
1000	12.2	16.3	20.5	21.7	25.0	28.1	31.0	34.6	38.3
MAX									
5	10.9	14.0	18.2	20.7	23.6	27.0	30.2	33.3	36.3
10	10.9	14.0	18.2	20.7	23.6	27.0	30.2	33.3	36.2
30	10.8	14.0	18.1	20.5	23.5	26.8	30.1	33.2	36.1
40	10.8	14.0	18.1	20.4	23.5	26.8	30.0	33.1	35.9
50	10.7	13.9	18.0	20.5	23.4	26.7	29.9	33.0	35.9
100	10.7	14.0	18.0	20.8	23.5	26.8	30.0	33.1	36.0
300	11.2	14.3	18.3	21.0	23.9	27.0	30.2	33.2	36.1
450	11.5	14.8	18.6	21.2	24.1	27.3	30.3	33.2	36.4
550	12.0	15.2	18.8	51.5	24.3	27.4	30.4	33.2	36.4
650	12.3	15.7	19.3	22.0	24.7	27.8	30.7	33.5	36.8
750	12.7	16.2	20.0	22.0	25.2	28.3	31.2	34.2	37.6
860	13.2	16.8	20.8	22.5	25.8	28.9	31.8	35.1	38.7
1000	13.8	17.9	22.1	23.3	26.6	29.7	32.6	36.2	39.9

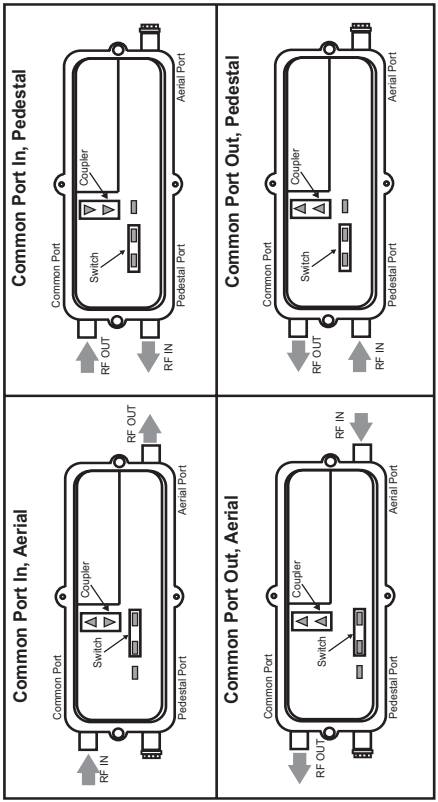
AMT System Design

AMT Tap Losses

Frequency AVE	LTC0	LTC4	LTC7	LTC10	LTC13	LTC16	LTC19	LTC22	LTC25
5	11.3	14.4	18.6	21.1	24.0	27.4	30.6	33.7	36.7
10	10.9	14.0	18.2	20.7	23.6	27.0	30.2	33.3	36.2
30	11.2	14.4	18.5	20.9	23.9	27.2	30.5	33.6	36.5
40	11.5	14.7	18.8	21.2	24.2	27.5	30.7	33.8	36.7
50	11.7	14.9	19.0	21.4	24.4	27.7	30.9	34.0	36.9
100	12.1	15.4	19.4	21.9	24.9	28.2	31.4	34.5	37.4
300	12.9	16.0	20.0	22.5	25.6	28.7	31.9	34.9	37.8
450	12.9	16.1	19.9	22.3	25.4	28.6	31.6	34.5	37.7
550	12.7	15.9	19.5	21.9	25.0	28.1	31.1	33.9	37.1
650	12.9	16.3	19.9	22.1	25.3	28.4	31.3	34.1	37.4
750	12.7	16.2	20.0	22.0	25.2	28.3	31.2	34.2	37.6
860	12.7	16.3	20.3	22.0	25.3	28.4	31.3	34.6	38.2
1000	13.3	17.4	21.6	22.8	26.1	29.2	32.1	35.7	39.4
MAX									
5	12.1	15.2	19.4	21.9	24.8	28.2	31.4	34.5	37.5
10	11.7	14.8	19.0	21.5	24.4	27.8	31.0	34.1	37.0
30	12.0	15.2	19.3	21.7	24.7	28.0	31.3	34.4	37.3
40	12.3	15.5	19.6	21.9	25.0	28.3	31.5	34.6	37.4
50	12.4	15.6	19.7	22.2	25.1	28.4	31.6	34.7	37.6
100	12.8	16.1	20.1	22.9	25.6	28.9	32.1	35.2	38.1
300	13.6	16.7	20.7	23.4	26.3	29.4	32.6	35.6	38.5
450	13.6	16.9	20.7	23.3	26.2	29.4	32.4	35.3	38.5
550	13.6	16.8	20.4	53.1	25.9	29.0	32.0	34.8	38.0
650	13.9	17.3	20.9	23.6	26.3	29.4	32.3	35.1	38.4
750	13.8	17.3	21.1	23.1	26.3	29.4	32.3	35.3	38.7
860	14.0	17.6	21.6	23.3	26.6	29.7	32.6	35.9	39.5
1000	14.9	19.0	23.2	24.4	27.7	30.8	33.7	37.3	41.0

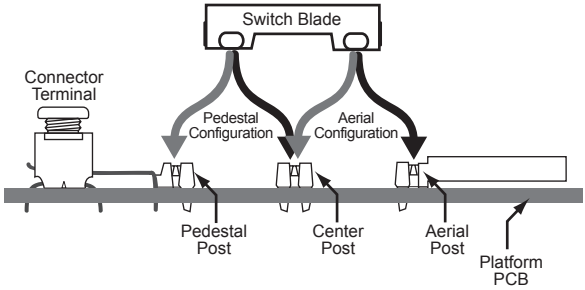
AMT Installation

Mounting Configurations



AMT Installation

Mounting Configurations



Basic Cable Theory Useful Technical Data

The Decibel

The decibel (dB) provides a means of representing large power ratios as manageable, small numbers, and allows the overall gains and losses in a module or a network to be calculated by addition and subtraction, rather than by multiplication and division.

The original unit is the Bel (named after Alexander Graham Bell). The decibel is one-tenth of a Bel. The power ratio of two power measurements is calculated as follows:

$$dB = 10 \cdot \log\left(\frac{P_1}{P_2}\right)$$

Ratio of power P1 to power P2, in dB:

The power ratio of two voltage measurements is calculated as follows:

Power ratio of voltage V1 to voltage V2, in dB:

$$dB = 20 \cdot \log\left(\frac{V_1}{V_2}\right)$$

Voltage Confusion

dBmV and dBµV expressions of power contain an upper case V. This does not mean they are expressions of voltage. They are expressions of power. When all the power scales (dBm, dBmV and dBµV) are laid next to each other, it is easy to see that each track on a dB for dB basis.

Power Conversions

dBmV

A power measurement of 'x dBmV' indicates that a particular signal is x dB greater than ('above') 1 millivolt in 75 ohms. A negative dBmV value indicates that the signal is x dB less than ('below') 1 millivolt in 75 ohms.

To convert x millivolts to dBmV:

$$\text{dBmV} = 20 \log (\text{x millivolts})$$

dBµV

Similarly, a measurement of 'x dBµV' indicates that the signal is x dB above one microvolt in 75 ohms.

To convert x microvolts to dBµV:

$$\text{dBµV} = 20 \log (\text{x microvolts})$$

To convert dBmV to dBµV, add 60 to the dBmV reading:

$$\text{x dBµV} = \text{x dBmV} + 60$$

dBm

A measurement of 'x dBm' indicates that a particular signal is x dB greater than ('above') 1 milliwatt. A negative dBm value indicates that the signal is x dB less than ('below') 1 milliwatt.

To convert x milliwatts to dBm:

$$\text{dBm} = 10 \log (\text{x milliwatts})$$

Power Conversion

A power level, in dBmV, can be converted directly to power in dBm, if the impedance, Z. is known:

To convert x dBmV directly to dBm:

$$dBm = 10 \cdot \log \left[\frac{10^{\left(\frac{x}{10}\right)}}{Z \cdot 1000} \right]$$

The inverse operation is also possible if impedance is known:

To convert dBm directly to dBmV:

$$dBmV = 10 \cdot \log \left[Z \cdot 1000 \cdot 10^{\left(\frac{x}{10}\right)} \right]$$

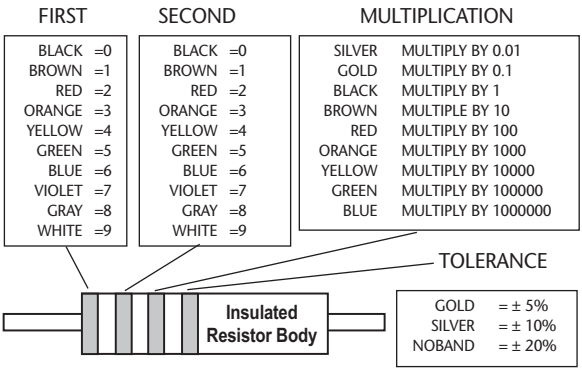
Impedance Mismatch

It frequently happens that the input impedance of a measuring device (spectrum analyzer; field strength meter, etc.) does not match the impedance of the system under test. In such a case, a correction must be made to the reading displayed on the instrument.

Where Zi is the impedance of the instrument, and Zs is the impedance of the system under test.

$$\text{Correction (in dB)} = 10 \cdot \log \left(\frac{Z_i}{Z_s} \right)$$

Standard Resistor Color Codes and Values



± 5% Standard Resistor Values (Ohm) Commonly available values. Values from 10 Ohm to 22 Mega Ohm by powers of 10.

1.0*	1.8*	3.3*	5.6*
1.1	2.0*	3.6	6.2
1.2*	2.2	3.9*	6.8*
1.3	2.4	4.3	7.5
1.5*	2.7*	4.7*	8.2
1.6	3.0	5.1	9.1

Standard Resistor Color Codes and Values

±1% Standard Resistor Values (Ohm)
Values from 10 Ohm to 22 Mega Ohm by powers of 10.

10.0	13.3	17.8	23.7	31.6	42.2	56.2	75.0
10.2	13.7	18.2	24.3	32.4	43.2	57.6	76.8
10.5	14.0	18.7	24.9	33.2	44.2	59.0	78.7
10.7	14.3	19.1	25.5	34.0	45.3	60.4	80.6
11.0	14.7	19.6	26.1	34.8	46.4	61.9	82.5
11.3	15.0	20.0	26.7	35.7	47.5	63.4	84.5
11.5	15.4	20.5	27.4	36.5	48.7	64.9	86.6
11.8	15.8	21.0	28.0	37.4	49.9	66.5	88.7
12.1	16.2	21.5	28.7	38.3	51.1	68.1	90.9
12.4	16.5	22.1	29.4	39.2	52.3	69.8	93.1
12.7	16.9	22.6	30.1	40.2	53.6	71.5	95.3
13.0	17.4	23.2	30.9	41.2	54.9	73.2	97.6

System Calculations

Carrier/Cross Modulation (XM)

1. Cross Modulation for One Amplifier at Operating Level:

$$XM = XM_{REF} + 2\,(\text{Output Level} - \text{Reference Level})$$

2. To Sum Identical Cross Modulation Ratios:

$$XM_S = XM - 20 \cdot \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different Cross Modulation Ratios:

$$XM = -20 \cdot \log_{10}\left(10^{\frac{-XM_1}{20}} + 10^{\frac{-XM_2}{20}} + 10^{\frac{-XM_n}{20}}\right)$$

See examples starting on pages 84.

4. Cross Modulation vs Channel Loading:

$$XM = -20 \cdot \log_{10}\left(10^{\frac{-XM_1}{20}} + 10^{\frac{-XM_2}{20}} + 10^{\frac{-XM_n}{20}}\right)$$

XM = Cross Modulation Ratio, expressed as a negative (-) number.

Rule: 1 dB change of the output of an amplifier will change the cross modulation by 2 dB.

Rule: For every double the number of amplifiers with identical cross modulation there is a 6 dB degradation in the total cross modulation.

FCC Requirement XM = 51 dB

N =	Number of equal contributors
NF =	Noise Figure
-59.2 =	Thermal Noise in 4 MHz Bandwidth (dBmV)

System Calculations

Carrier/Composite Triple Beat (CTB)

1. Composite Triple Beat for One Amplifier at Operating Level:

$$CTB = CTB_{REF} + 2\,(\text{Output Level} - \text{Reference Level})$$

2. To Sum Identical Composite Triple Beat Ratios:

$$CTB_S = CTB - 20 \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different Composite Triple Beat Ratios:

$$CTB_S = -20 \log_{10}\left(10^{\frac{-CTB_1}{20}} + 10^{\frac{-CTB_2}{20}} + 10^{\frac{-CTB_n}{20}}\right)$$

See examples starting on pages 84.

4. Composite Triple Beat vs Channel Loading:

$$DCTB = 10 \log_{10}\left(\frac{\text{Beat Qty}_{new}}{\text{Beat Qty}_{ref}}\right)$$

A 1 dB change of the output of an amplifier will change the CTB ratio by 2 dB.

For every double the number of amplifiers with identical CTB, there is a 6 dB degradation in the total CTB ratio.

FCC Requirement CTB:

Standard = 51 dB
IRC = 47 dB
HRC = 47 dB

System Calculations

Carrier/Single Second Order Distortion (C/SSO)

1. Single Second Order Beat for One Amplifier at Operating Level:

$$SSO = SSO_{REF} + (\text{Output Level} - \text{Reference Level})$$

2. To Sum Identical SSO Ratios:

$$SSO_S = SSO - 10 \cdot \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different SSO Ratios:

$$SSO_S = -10 \log_{10}\left(10^{\frac{-SSO_1}{10}} + 10^{\frac{-SSO_2}{10}} + 10^{\frac{-SSO_n}{10}}\right)$$

A 1 dB change of the output of an amplifier will change SSO by 1 dB.

The 10 log assumptions shown here for second order are conservative. Some engineers use 13 log or 15 log assumptions.

FCC Requirement SSO = 51 dB

System Calculations

Carrier/Composite Second Order Distortion (C/CSO)

1. Composite Second Order for One Amplifier at Operating Level:

$$CSO = CSO_{REF} + (\text{Output Level} - \text{Reference Level})$$

2. To Sum Identical CSO Ratios:

$$CSO_S = CSO - 15 \bullet \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different CSO Ratios:

$$CSO_S = -15 \log_{10}\left(10^{\frac{-CSO_1}{15}} + 10^{\frac{-CSO_2}{15}} + 10^{\frac{-CSO_n}{15}}\right)$$

See examples starting on pages 84.

4. CSO vs Channel Loading:

$$\Delta CSO = 10 \log_{10}\left(\frac{\text{CSO Beat Qty}_{new}}{\text{CSO Beat Qty}_{ref}}\right)$$

A 1 dB change of the output of an amplifier will change CSO by 1 dB.

FCC Requirement CSO = 51 dB

System Calculations

Composite Intermodulation Noise (CIN)

It is assumed that CIN is dominated by 3rd order distortion (CIN3). This is the case in systems with analog television channels to 550 MHz and digital video above 550 MHz.

1. Composite Intermodulation Noise for One Amplifier at Operating Level.

$$CIN = CIN_{REF} + 2\,(\text{Output Level} - \text{Reference Level})$$

2. To Sum Identical Composite Intermodulation Noise Ratios:

$$CIN_S = CIN - 20 \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different Composite Intermodulation Noise Ratios:

$$CIN_S = -20 \log_{10}\left(10^{\frac{-CIN_1}{20}} + 10^{\frac{-CIN_2}{20}} + 10^{\frac{-CIN_3}{20}}\right)$$

See examples starting on pages 84.

4. To Sum Carrier/Noise and Composite Intermodulation Ratios:

$$C/N_s = 10 \log_{10}\left(10^{\frac{-CIN}{20}} + 10^{\frac{-C/N}{20}}\right)$$

Rule: CIN behaves like CTB in a cascade of amplifiers, but it adds to the C/N noise.

System Calculations

Carrier/Hum Modulation (C/H)

1. To Sum Identical Carrier/Hum Ratios:

$$C/H_S = C/H - 20 \bullet \log_{10} N$$

See charts & examples starting on pages 84.

2. To Sum Different Carrier/Hum Ratios:

$$C/H_S = -20 \bullet \log_{10}\left(10^{\frac{-C/H_1}{20}} + 10^{\frac{-C/H_2}{20}} + 10^{\frac{-C/H_n}{20}}\right)$$

See examples starting on page 84.

Note: Above calculations assume connection of all power supplies to the same powerline phase.

3. To Convert Percent Hum to C/H Ratio:

$$C/H\ (dB) = 20 \bullet \log_{10}\left(\frac{\%\ Hum}{100}\right)$$

4. To Convert C/H Ratio to % Hum:

$$Percent\ Hum = 10^{\frac{-C/H}{20}} \bullet 100$$

System Calculations

Carrier/Noise

1. The Carrier/Noise contribution of a single amplifier when the Noise Figure (NF) is known:

$$C/N_o = \text{Input Level} + 59.2 - NF$$

2. To Sum Identical Carrier/Noise Ratios:

$$C/N_o = C/N - 10 \cdot \log_{10} N$$

See charts & examples starting on pages 84.

3. To Sum Different Carrier/Noise Ratios:

$$C/N_S = -10 \cdot \log_{10}\left(10^{\frac{-C/N_1}{10}} + 10^{\frac{-C/N_2}{10}} + 10^{\frac{-C/N_n}{10}}\right)$$

See examples starting on pages 84.

4. Carrier/Noise Ratio vs Bandwidth:

$$\Delta C/N = 10 \cdot \log_{10}\left(\frac{\text{Bandwidth}_{new}}{\text{Bandwidth}_{ref}}\right)$$

Rule: For every 1 dB increase in input signal level, the C/N improves by 1 dB. For every double the number of amplifiers with identical Carrier/Noise Ratios there is a degradation of 3 dB in the total C/N.

FCC Requirement C/N = 43 dB

N	=	Number of equal contributors
NF	=	Noise Figure
-59.2	=	Thermal Noise in 4 MHz Bandwidth (dBmV)

System Calculations

TVRO Formulas

1. System Gain Over Temperature

$$G/T = Ag - 10 \log (AT + LNAT)$$

Ag = Antenna Gain (dB)
AT = Antenna Temperature (°K)
LNAT = Low Noise Amp Temperature (°K)

2. Carrier to Noise Ratio*

$$C/N = G/T + EIRP - 43$$

3. C/N for other RxBw

$$\left[C/N = (10 \log \frac{30}{X}) \right]$$

4. Convert C/N to S/N*

$$S/N = C/N + 38$$

5. Declination Angle (Polar Mount Antenna)

$$\text{Declination} = \tan^{-1} \frac{3964 \sin L}{22300 + 3964 (1 - \cos L)}$$

3964 = Radius of the Earth
22300 = Distance to Satellite Arc
L = Site Latitude

* RxBw = 30 MHz

System Calculations

Aximuth and Elevation Angles

Antenna pointing angles can be calculated in degrees from true north from the following equations:

$$\text{Azimuth Angle} = \cos^{-1}[-\tan\Phi / \tan Y]$$

$$\text{Elevation Angle} = \tan^{-1}[(\cos Y - 0.15116) / \sin Y]$$

$$Y = \cos^{-1}[\cos\Phi \cos\Delta]$$

Where Δ is the absolute value of the difference between satellite and TVRO site longitudes and Φ is the site latitude.

Noise Temperature & Noise Figure

Noise Figure (dB)	Noise Temperature (°K)	Noise Figure (dB)	Noise Temperature (°K)
2.0	170	0.9	67
1.9	159	0.8	59
1.8	149	0.7	51
1.7	139	0.6	43
1.6	129	0.5	35
1.5	120	0.4	28
1.4	110	0.3	21
1.3	101	0.2	14
1.2	92	0.1	7
1.1	84		00
1.0	75		

System Calculations

Determining Acceptable Peak-to-Valley Deviation

To determine what degree of overall peak-to-valley deviation is acceptable for the Nth amplifier in a cascade, use this formula.

$$X \text{ (in dB)} = \frac{N}{10} + 1$$

Where x is equal to the acceptable P-V deviation and, N = number of amplifiers in cascade.

For example, what is the maximum acceptable peak-to-valley deviation at the 32nd amplifier in a cascade?

$$X = \frac{32}{10} + 1 = 4.2 \text{ dB}$$

Thus, 4.2 dB is the maximum acceptable peak-to-valley deviation (highest peak to lowest valley in the broadband signal) at the 32nd amplifier.

System Calculations

Amplifier Cascade Factor

CASCADE (N)	C/N + SSO 10*LOG(N)	CSO 15*LOG(N)	CTB & XMOD 20*LOG(N)
1	0.00	0.00	0.00
2	3.01	4.52	6.02
3	4.77	7.16	9.54
4	6.02	9 03	12.04
5	6.99	10.48	13.98
6	7.78	11.67	15.56
7	8.45	12.68	16.90
8	9.03	13.55	18.06
9	9.54	14.31	19.08
10	10.00	15.00	20.00
11	10.41	15.62	20.83
12	10.79	16.19	21.58
13	11.14	16.71	22.28
14	11.46	17.19	22.92
15	11.76	17.64	23.52
16	12.04	18.06	24.08
17	12.30	18.46	24.61
18	12.55	18.83	25.11
19	12.79	19.18	25.58
20	13.01	19.52	26.02
21	13.22	19.83	26.44
22	13.42	20.14	26.85
23	13.62	20.43	27.23
24	13.80	20.70	27.60
25	13.98	20.97	27.96

System Calculations

Amplifier Cascade Factor - Example

The Amplifier Cascade Factor Chart (on previous page) is used to predict performance considering the contribution of various numbers of amplifiers. It assumes that all amplifiers are operated at the same level (input level for noise, output level for distortion). This is generally the case in a Unity Gain Based System.

Example: What is the trunk CTB after 13 trunk amplifiers?

Given:
1. Single trunk amplifier CTB specification is 87 dB @ 32 dBmV flat (from Manufacturers specs.)
2. Trunk output is 25 dBmV, channel 2 Trunk output is 32 dBmV, channel 60 (7 dB linear tilt)

Step 1 Re-rate performance of single amp based on actual operating level.

Geometric tilt center = 28.5 dBmV

Add .5 dB correction factor = 29 dBmV average level

32 - 29 = 3 dB x 2 (for CTB) = 6 dB

87 dB + 6 dB = 93 dB CTB @ 29 dBmV average level

Step 2 Find cascade factor for CTB for 13 amps, on the chart = 22.28 dB

Step 3 Subtract cascade factor from single amp operating performance

93 dB - 22.28 = 70.72 dB
CTB = 70.72 dB after 13 amps

System Calculations

Note: Summing different ratios requires a grasp of the antilog concept. For brevity, the example shown is for CTB only, but the approach is identical for all system distortion and noise calculations.

Determine End Of Line CTB Given The Following:

10 Trunk CTB = 65 dBc
1 Bridger CTB = 60 dBc
3 Line Extender CTB = 58 dBc

Step 1. $CTB_S = 20 \log (10^{\frac{-65}{20}} + 10^{\frac{-60}{20}} + 10^{\frac{-58}{20}})$

Step 2. $CTB_S = 20 \log (10^{-3.25} + 10^{-3.00} + 10^{-2.90})$

CTB_S 20 log (antilog -3.25 + antilog -3.00 + antilog -2.90)

Note: To perform the operations in step 2, use the "inverse" log or "antilog" function on most calculators. Antilog (Inverse Log) is used to re-express the different exponent values to voltage so the amounts may be easily summed. Don't forget the minus sign.

Step 3. $CTB_S = 20 \log (5.62 \times 10^{-4} + 1 \times 10^{-3} + 1.26 \times 10^{-3})$

Step 4. $CTB_S = 20 \log (5.62 \times 10^{-4} + 10 \times 10^{-4} + 12.6 \times 10^{-4})$

Step 5. $CTB_S = 20 \log (28.12 \times 10^{-4})$

CTB = 51 dBc

The 20 Log and 10 Log function derate charts & example on pages 86, 87 and 88 may also be used to sum different ratios if a scientific calculator is not available.

20 Log Function Derate Chart

(use for CTB and XMOD)

diff (dB)	SUBTRACTION VALUES									
	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
0	6.02	5.97	5.92	5.87	5.82	5.77	5.73	5.68	5.63	5.58
1	5.53	5.49	5.44	5.39	5.35	5.30	5.26	5.21	5.17	5.12
2	5.08	5.03	4.99	4.95	4.90	4.86	4.82	4.78	4.73	4.69
3	4.65	4.61	4.57	4.53	4.49	4.45	4.41	4.37	4.33	4.29
4	4.25	4.21	4.17	4.13	4.10	4.06	4.02	3.98	3.95	3.91
5	3.88	3.84	3.80	3.77	3.73	3.70	3.66	3.63	3.60	3.56
6	3.53	3.50	3.46	3.43	3.40	3.36	3.33	3.30	3.27	3.24
7	3.21	3.18	3.15	3.12	3.09	3.06	3.03	3.00	2.97	2.94
8	2.91	2.88	2.85	2.83	2.80	2.77	2.74	2.72	2.69	2.66
9	2.64	2.61	2.59	2.56	2.53	2.51	2.48	2.46	2.44	2.41
10	2.39	2.36	2.34	2.32	2.29	2.27	2.25	2.22	2.20	2.18
11	2.16	2.13	2.11	2.09	2.07	2.05	2.03	2.01	1.99	1.97
12	1.95	1.93	1.91	1.89	1.87	1.85	1.83	1.81	1.79	1.77
13	1.75	1.74	1.72	1.70	1.68	1.67	1.65	1.63	1.61	1.60
14	1.58	1.56	1.55	1.53	1.51	1.50	1.48	1.47	1.45	1.44
15	1.42	1.41	1.39	1.38	1.36	1.35	1.33	1.32	1.31	1.29
16	1.28	1.26	1.25	1.24	1.22	1.21	1.20	1.19	1.17	1.16
17	1.15	1.14	1.12	1.11	1.10	1.09	1.08	1.06	1.05	1.04
18	1.03	1.02	1.01	1.00	0.99	0.98	0.96	0.95	0.94	0.93
19	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84
20	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.77	0.76	0.75
21	0.74	0.73	0.73	0.72	0.71	0.70	0.69	0.69	0.68	0.67
22	0.66	0.66	0.65	0.64	0.64	0.63	0.62	0.61	0.61	0.60
23	0.59	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.54	0.54
24	0.53	0.53	0.52	0.51	0.51	0.50	0.50	0.49	0.49	0.48
25	0.48	0.47	0.46	0.46	0.45	0.45	0.44	0.44	0.43	0.43
26	0.42	0.42	0.42	0.41	0.41	0.40	0.40	0.39	0.39	0.38
27	0.38	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.35	0.34
28	0.34	0.34	0.33	0.33	0.32	0.32	0.32	0.31	0.31	0.31
29	0.30	0.30	0.30	0.29	0.29	0.29	0.28	0.28	0.28	0.27
30	0.27	0.27	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.24
31	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.22
32	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.19
33	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.17
34	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.15
35	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14
36	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12
37	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11
38	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10
39	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
40	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

10 Log Function Derate Chart

(use for CNR and SSO)

diff (dB)	SUBTRACTION VALUES 0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
0	3.01	2.96	2.91	2.86	2.81	2.77	2.72	2.67	2.63	2.58
1	2.54	2.50	2.45	2.41	2.37	2.32	2.28	2.24	2.20	2.16
2	2.12	2.09	2.05	2.01	1.97	1.94	1.90	1.87	1.83	1.80
3	1.76	1.73	1.70	1.67	1.63	1.60	1.57	1.54	1.51	1.48
4	1.46	1.43	1.40	1.37	1.35	1.32	1.29	1.27	1.24	1.22
5	1.19	1.17	1.15	1.12	1.10	1.08	1.06	1.04	1.01	0.99
6	0.97	0.95	0.93	0.91	0.90	0.88	0.86	0.84	0.82	0.81
7	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.68	0.67	0.65
8	0.64	0.63	0.61	0.60	0.59	0.57	0.56	0.55	0.54	0.53
9	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.42
10	0.41	0.40	0.40	0.39	0.38	0.37	0.36	0.35	0.35	0.34
11	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.28	0.28	0.27
12	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22
13	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17
14	0.17	0.17	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14
15	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11
16	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09
17	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07
18	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06
19	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04
20	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
21	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
22	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
23	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
24	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
25	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Combining Two X-MOD or CTB Performance Ratings (20 Log)

10 Trunk CTB = 65 dBc
1 Bridger CTB = 60 dBc
Line Extender CTB = 58 dBc

Using dB Subtraction Values

The 20 log & 10 log derate charts are used to sum different ratios. The following example demonstrates how:

Step 1 Sum Trunk and Bridger CTB

1.1 Find the dB difference between the two ratios (65-60=5 dB)

1.2 Look up the derate (dB Subtraction) for 5.0 dB difference in the chart (3.88 dB)

1.3 Derate the poorer of the two CTB ratios by this amount (60-3.9=56.1 dBc)

Step 2 Sum the Sum of Trunk and Bridger from Step 1 with the line extenders

2.1 Find the dB difference between the two ratios (58-56.12=1.88)

2.2 Look up the derate (dB Subtraction) for 1.88 dB difference in the chart (5.12) (round 1.88 up to 1.9).

2.3 Derate the poorer of the two CTB ratios by this amount (56.12 - 5.12 = 51.0 dBc)

Combining Two CNR or SSO Performance Ratings (10 Log)

10 Trunk CNR = 56.5 dB
1 Bridger CNR = 65 dB

Using dB Subtraction Values

Example: Combine trunk and bridger CNR to find the resultant CNR at the Bridger output (no line extenders).

dB difference = 65-56.5 = 8.5 dB

dB subtraction figure = 0.6 dB

Bridger output CNR = 56.5-0.6 = 55.9 dB

So then, the resultant CNR measure is about 55.9 dB.

Beat Packet Quantity

Frequency	330 MHz 40 Channels CTB	CSO	450 MHz 60 Channels CTB	CSO	550 MHz 77 Channels CTB	CSO	600 MHz 85 Channels CTB	CSO	750 MHz 110 Channels CTB	CSO
55.25	225	2	615	2	1104	2	1384	2	2465	2
61.25	240	2	640	2	1137	2	1421	2	2515	2
67.25	251	2	661	2	1167	2	1455	2	2561	2
77.25	36	25	56	45	73	62	81	70	106	95
83.25	36	24	56	44	73	61	81	69	106	94
121.25	368	2	868	2	1450	2	1774	2	2993	2
127.25	384	2	894	2	1485	2	1813	2	3044	2
133.25	398	2	918	2	1517	2	1849	2	3093	2
139.25	409	2	939	2	1547	2	1883	2	3139	2
145.25	420	2	960	2	1576	2	1916	2	3185	2
151.25	429	2	979	2	1604	2	1948	2	3229	2
157.25	438	2	998	2	1631	2	1979	2	3273	2
163.25	445	2	1015	2	1657	2	2009	2	3315	2
169.25	452	2	1032	2	1682	2	2038	2	3357	2
175.25	458	2	1048	2	1707	2	2067	2	3398	2
181.25	464	2	1064	2	1731	2	2095	2	3439	2
187.25	469	3	1079	3	1755	3	2123	3	3479	3
193.25	473	3	1093	3	1777	3	2149	3	3518	3
199.25	476	3	1106	3	1799	3	2175	3	3556	3
205.25	478	3	1118	3	1819	3	2199	3	3593	3
211.25	479	3	1129	3	1839	3	2223	3	3629	3
217.25	479	3	1139	3	1857	3	2245	3	3664	3
223.25	478	3	1148	3	1875	3	2267	3	3698	3
229.25	476	3	1156	3	1891	3	2287	3	3731	3
235.25	473	3	1163	3	1907	3	2307	3	3763	3
241.25	469	4	1169	4	1921	4	2325	4	3794	4
247.25	464	4	1174	4	1935	4	2343	4	3824	4
253.25	458	5	1178	5	1947	5	2359	5	3853	5
259.25	451	5	1181	5	1959	5	2375	5	3881	5
265.25	443	6	1183	6	1969	6	2389	6	3908	6
271.25	435	6	1184	6	1979	6	2403	6	3934	6
277.25	427	7	1184	7	1987	7	2415	7	3959	7
283.25	419	7	1183	7	1995	7	2427	7	3983	7
289.25	410	8	1181	8	2001	8	2437	8	4006	8
295.25	400	8	1178	8	2007	8	2447	8	4028	8
301.25	389	9	1174	9	2011	9	2455	9	4049	9
307.25	377	9	1169	9	2015	9	2463	9	4069	9
313.25	364	10	1163	10	2017	10	2469	10	4088	10
319.25	349	10	1156	10	2019	10	2475	10	4106	10
325.25	331	11	1148	11	2019	11	2479	11	4123	11
331.25			1139	11	2019	11	2483	11	4139	11
337.25			1129	12	2017	12	2485	12	4154	12
343.25			1118	12	2015	12	2487	12	4168	12
349.25			1106	13	2011	13	2487	13	4181	13
355.25			1093	13	2007	13	2487	13	4193	13
361.25			1079	14	2001	14	2485	14	4204	14
367.25			1064	14	1995	14	2483	14	4214	14
373.25			1048	15	1987	15	2479	15	4223	15
379.25			1031	15	1979	15	2475	15	4231	15
385.25			1013	16	1969	16	2469	16	4238	16
391.25			995	16	1959	16	2463	16	4244	16
397.25			977	17	1947	17	2455	17	4249	17
403.25			959	17	1935	17	2447	17	4253	17
409.25			940	18	1921	18	2437	18	4256	18
415.25			920	18	1907	18	2427	18	4258	18

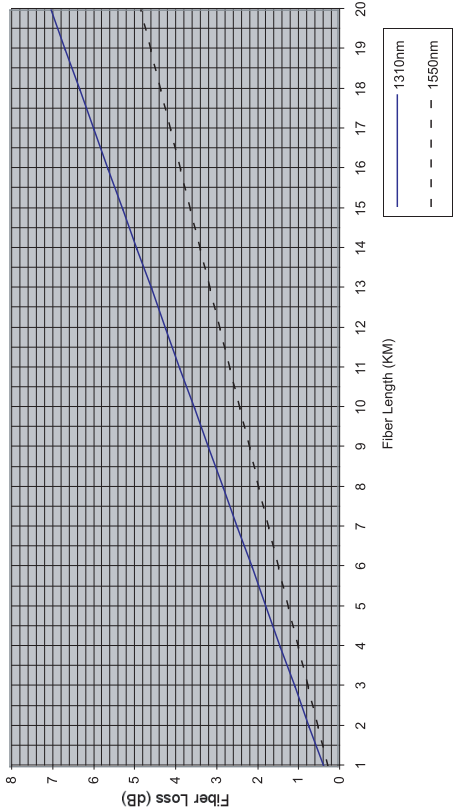
Continued...

Beat Packet Quantity

Frequency	330 MHz 40 Channels CTB	CSO	450 MHz 60 Channels CTB	CSO	550 MHz 77 Channels CTB	CSO	600 MHz 85 Channels CTB	CSO	750 MHz 110 Channels CTB	CSO
421.25			899	19	1891	19	2415	19	4259	19
427.25			877	19	1875	19	2403	19	4259	19
433.25			854	20	1857	20	2389	20	4258	20
439.25			829	20	1839	20	2375	20	4256	20
445.25			801	21	1819	21	2359	21	4253	21
451.25					1799	21	2343	21	4249	21
457.25					1777	22	2325	22	4244	22
463.25					1755	22	2307	22	4238	22
469.25					1731	23	2287	23	4231	23
475.25					1707	23	2267	23	4223	23
481.25					1681	24	2245	24	4214	24
487.25					1655	24	2223	24	4204	24
493.25					1628	25	2199	25	4193	25
499.25					1602	25	2175	25	4181	25
505.25					1575	26	2149	26	4168	26
511.25					1548	26	2123	26	4154	26
517.25					1519	27	2095	27	4139	27
523.25					1490	27	2067	27	4123	27
529.25					1459	28	2037	28	4106	28
535.25					1428	28	2007	28	4088	28
541.25					1394	29	1976	29	4069	29
547.25					1358	29	1946	29	4049	29
553.25							1915	30	4028	30
559.25							1884	30	4006	30
565.25							1851	31	3983	31
571.25							1818	31	3959	31
577.25							1783	32	3934	32
583.25							1748	32	3908	32
589.25							1710	33	3881	33
595.25							1670	33	3853	33
601.25									3824	34
607.25									3794	34
613.25									3763	35
619.25									3731	35
625.25									3698	36
631.25									3664	36
637.25									3629	37
643.25									3593	37
649.25									3556	38
655.25									3518	38
661.25									3479	39
667.25									3439	39
673.25									3398	40
679.25									3356	40
685.25									3313	41
691.25									3270	41
697.25									3227	42
703.25									3184	42
709.25									3140	43
715.25									3095	43
721.25									3049	44
727.25									3002	44
733.25									2954	45
739.25									2904	45
745.25									2851	46

Fiber Optics

Fiber Loss vs Path Length - Single Mode @1550 nm



Fiber Optics

Siecor MIC™ Cable Fiber Identification Guide

(SOLID) 1 -1O		(DASHED) 11 -20		(STRIPED) 21-30	
1	Blue	11	Blue + Black Dash	21	Blue + Black Stripe
2	Orange	12	Orange+ Black Dash	22	Orange+ Black Stripe
3	Green	13	Green+ Black Dash	23	Green+ Black Stripe
4	Brown	14	Brown+ Black Dash	24	Brown+ Black Stripe
5	Slate	15	Slate+ Black Dash	25	Slate+ Black Stripe
6	White	16	White+ Black Dash	26	White+ Black Stripe
7	Red	17	Red+ Black Dash	27	Red+ Black Stripe
8	Black	18	Black+ White Dash	28	Black+ White Stripe
9	Yellow	19	Yellow+ Black Dash	29	Yellow+ Black Stripe
10	Violet	20	Violet+ Black Dash	30	Violet+ Black Stripe

Standard Single Mode Fiber

Wavelength	Attenuation	Dispersion
1310 nm	0.35 dB/km	3 ps/(nm•km)
1550 nm	0.24 dB/km	19 ps/(nm•km)

Wavelength Division Multiplexers (WDM)

Wavelengths	1310/1550 nm
Bandpass	+ 20 nm
Insertion Loss	< 0.5 dB
Directivity	≥ 60 dB

Amphenol Optical Connectors

	SC-FC/APC	Super SC-FC/PC
Insertion Loss	≤ 0.3 dB	≤ .15 dB
Back Reflection	≤ -65 dB	≤ -45 dB

Fiber Optics

Converting MW to DBM

Use the conversion table below, to convert milliwatts (mW) to decibel milliwatts (dBm).

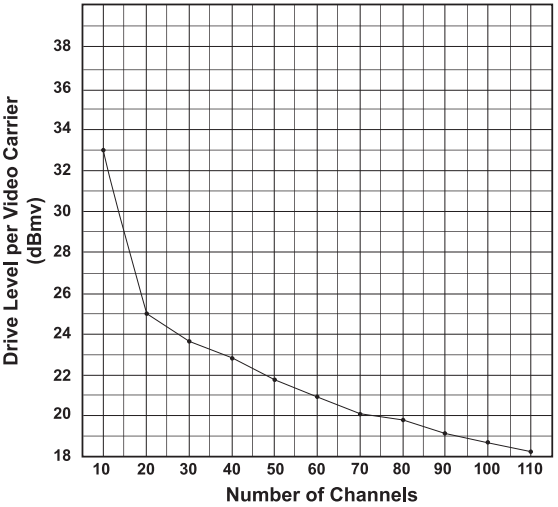
mW	dBm	mW	dBm
0.1	-10.0	2.0	3.01
0.2	-6.99	3.0	4.77
0.3	-5.23	4.0	6.02
0.4	-3.97	5.0	6.99
0.5	-3.00	6.0	7.78
0.6	-2.20	7.0	8.45
0.7	-1.55	8.0	9.03
0.8	-0.96	9.0	9.54
0.9	-0.45	10.0	10.00
1.0	0.00	11.0	10.41
1.1	0.41	12.0	10.79
1.2	0.79	13.0	11.14
1.3	1.14	14.0	11.46
1.4	1.46	15.0	11.76
1.5	1.76	16.0	12.04
1.6	2.04	17.0	12.30
1.7	2.30	18.0	12.55
1.8	2.55	19.0	12.79
1.9	2.79	20.0	13.01

Fiber Optics

Transmitter Design Tool

FIBT/MIBT-S3A-8XX & FIBT-10-1550

The optimal RF input level needed at the transmitter is based on channel loading. Find the channel loading figure on the X axis on the chart below. Follow this intersection across to the Y axis to determine the RF input level. This is the level that you need to apply to the transmitter to ensure a quality signal for your channel loading configuration.



Fiber Optics

FRDA/FRRA Series RF Attenuation Requirements

The RF output level from the optical receiver module varies considerably over its operational optical input range. It is also dependent upon the transmitter's channel loading, its resultant RF input level and the FRRA/FRDA RF output capability. In order not to overload the amplifier section input, an internal attenuator must be installed. To find the recommended attenuator value, first determine the receivers optical input level as noted in the "Input Optical Power". Refer to the Configuration Table below, locate the power monitor voltage or input dBm in the left hand columns. Read across on the corresponding row to find the value required.

	Model		FRRA-S4A-860P
	CH. Loading		110 CH.
	Output Level		34/42
	Optical Input dBm	mW	
	-10	0.10	Increase Optical Input Power
	-9	0.13	Orange Optical LED Indication
	-8	0.16	
	-7	0.20	
	-6	0.25	0 dB
	-5	0.32	2 dB
G	-4	0.40	4 dB
R	-3	0.50	6 dB
E	-2	0.63	Recommended Attenuator Value 8 dB
E	-1	0.79	10 dB
N	0	1.00	12 dB
L	1	1.26	14 dB
E	2	1.58	16 dB
D	3	2.00	18 dB
	4	2.51	Decrease Optical Input Power
	5	3.16	Red Optical LED Indication

Fiber Optics

FIBT Design Tool

Laser Power Monitor

This jack allows accurate measurements of the optical output power with a standard voltmeter. The voltage is scaled at 0.1VDC per mW of optical output.

Therefore, mW = VDC x 10.
Output level in dBm = 10 x LOG(mW).

Example: A 1.0 VDC reading is therefore a 10 mW or 10 dBm of optical output power. Refer to the table below.

Laser Power Monitor 0.1 V/mW		
VDC	**dBm**	**mW**
0.25	4	2.51
0.32	5	3.16
0.40	6	3.98
0.50	7	5.01
0.63	8	6.31
0.79	9	7.94
1.00	10	10.00
1.26	11	12.59
1.59	12	15.85
2.00	13	19.95
2.51	14	25.12
3.16	15	31.62
3.98	16	39.81

Fiber Optics

Optical Coupler Design Tool

Coupler Ports	Ratio	Loss (dB)
1 x 2	50/50	3.6/3.6
	40/60	4.7/2.7
	30/70	6.0/1.9
	20/80	7.9/1.2
	10/90	11.3/0.6
	5/95	15.1/0.5
Coupler Ports	Ratio	Loss (dB)
1 x 3	33/33/33	6.0/6.0/6.0
	40/30/30	4.7/6.4/6.4
	50/25/25	3.6/7.3/7.3
	60/20/20	2.7/8.4/8.4
	70/15/15	1.9/9.6/9.6
	80/10/10	1.2/11.3/11.3
Coupler Ports	Ratio	Loss (dB)
1 x 4	25% per port	7.3 per port
Coupler Ports	Ratio	Loss (dB)
1 x 6	16.6% per port	9.7 per port
Coupler Ports	Ratio	Loss (dB)
1 x 8	12.5% per port	10.8 per port

Frequency Charts

CATV Channels, North America

	EIA	Standard		Incremental		Harmonic	
CH.	CH.	Video	Audio	Video	Audio	Video	Audio
T7	none	7.0000	11.5000	NA	NA	NA	NA
T8	none	13.0000	17.5000	NA	NA	NA	NA
T9	none	19.0000	23.5000	NA	NA	NA	NA
T10	none	25.0000	29.5000	NA	NA	NA	NA
T11	none	31.0000	35.5000	NA	NA	NA	NA
T12	none	37.0000	41.5000	NA	NA	NA	NA
T13	none	43.0000	47.5000	NA	NA	NA	NA
T14	none	49.0000	53.5000	NA	NA	NA	NA
2	02	55.2500	59.7500	55 2625	59.7625	54.0027	58.5027
3	03	61.2500	65.7500	61.2625	65.7625	60.0030	64.5030
4	04	67.2500	71.7500	67.2625	71.7625	66.0033	70.5030
A8	01	NA	N A	73.2625	77.7625	72.0036	76.5036
5	05	77.2500	81.7500	79.2625	83.7625	78.0039	82.5039
6	06	83.2500	87.7500	85.2625	89.7625	84.0042	88.5042
A5	95	91.2500	95.7500	91.2625	95.7625	90.0045	94.5045
A4	96	97.2500	101.7500	97.2625	101.7625	96.0048	100.5048
A3	97	103.2500	107.7500	103.2625	107.7625	102.0051	106.5051
A2	98*	109.2750	113.7750	109.2750	113.7750	Cannot lock to comb	
A1	99*	115.2750	119.7750	115.2750	119.7750	ref: refer to FCC regs	
A	14*	121.2625	125.7625	121.2625	125.7625	120.0060	124.5060
B	15*	127.2625	131.7625	127.2625	131.7625	126.0063	130.5063
C	16*	133.2625	137.7625	133.2625	137.7625	132.0066	136.5066
D	17	139.2500	143.7500	139.2625	143.7625	138.0069	142.5069
E	18	145.2500	149.7500	145.2625	149.7625	144.0072	148.5072
F	19	151.2500	155.7500	151.2625	155.7625	150.0075	154.5075
G	20	157.2500	161.7500	157.2625	161.7625	156.0078	160.5078
H	21	163.2500	167.7500	163.2625	167.7625	162.0081	166.5081
I	22	169.2500	173.7500	169.2625	173.7625	168.0084	172.5084
7	07	175.2500	179.7500	175.2625	179.7625	174.0087	178.5087
8	08	181.2500	185.7500	181.2625	185.7625	180.0090	184.5090
9	09	187.2500	191.7500	187.2625	191.7625	186.0093	190.5093
10	10	193.2500	197.7500	193.2625	197.7625	192.0096	196.5096
11	11	199.2500	203.7500	199.2625	203.7625	198.0099	202.5099
12	12	205.2500	209.7500	205.2625	209.762	204.0102	208.5102
13	13	211.2500	215.7500	211.2625	215.7625	210.0105	214.5105
J	23	217.2500	221.7500	217.2625	221.7625	216.0108	220.5108
K	24*	223.2500	227.7500	223.2625	227.7625	222.0111	226.5111
L	25*	229.2625	233.7625	229.2625	233.7625	228.0114	232.5114

* Means aeronautical channels visual carrier frequency tolerance ± 5 kHz

Frequency Charts

CATV Channels, North America

CH.	EIA CH.	Standard		Incremental		Harmonic	
		Video	Audio	Video	Audio	Video	Audio
M	26*	235.2625	239.7625	235.2625	239.7625	234.0117	238.5117
N	27*	241.2625	245.7625	241.2625	245.7625	240.0120	244.5120
O	28*	247.2625	251.7625	247.2625	251.7625	246.0123	250.5123
P	29*	253.2625	257.7625	253.2625	257.7625	252.0126	256.5126
Q	30*	259.2625	263.7625	259.2625	263.7625	258.0129	262.5129
R	31*	265.2625	269.7625	265.2625	269.7625	264.0132	268.5132
S	32*	271.2625	275.7625	271.2625	275.7625	270.0135	274.5135
T	33*	277.2625	281.7625	277.2625	281.7625	276.0138	280.5138
U	34*	283.2625	287.7625	283.2625	287.7625	282.0141	286.5141
V	35*	289.2625	293.7625	289.2625	293.7625	288.0144	292.5144
W	36*	295.2625	299.7625	295.2625	299.7625	294.0147	298.5147
AA	37*	301.2625	305.7625	301.2625	305.7625	300.0150	304.5150
BB	38*	307.2625	311.7625	307.2625	311.7625	306.0153	310.5153
CC	39*	313.2625	317.7625	313.2625	317.7625	312.0156	316.5156
DD	40*	319.2625	323.7625	319.2625	323.7625	318.0159	322.5159
EE	41*	325.2625	329.7625	325.2625	329.7625	324.0162	328.5162
FF	42*	331.2750	335.7750	331.2750	335.7750	330.0165	334.5165
GG	43*	337.2625	341.7625	337.2625	341.7625	336.0168	340.5168
HH	44*	343.2625	347.7625	343.2625	347.7625	342.0168	346.5168
II	45*	349.2625	353.7625	349.2625	353.7625	348.0168	352.5168
JJ	46*	355.2625	359.7625	355.2625	359.7625	354.0168	358.5168
KK	47*	361.2625	365.7625	361.2625	365.7625	360.0168	364.5168
LL	48*	367.2625	371.7625	367.2625	371.7625	366.0168	370.5168
MM	49*	373.2625	377.7625	373.2625	377.7625	372.0168	376.5168
NN	50*	379.2625	383.7625	379.2625	383.7625	378.0168	382.5168
00	51*	385.2625	389.7625	385.2625	389.7625	384.0168	388.5168
PP	52*	391.2625	395.7625	391.2625	395.7625	390.0168	394.5168
QQ	53*	397.2625	401.7625	397.2625	401.7625	396.0168	400.5168
RR	54	403.2500	407.7500	403.2625	407.7625	402.0201	406.5201
SS	55	409.2500	413.7500	409.2625	413.7625	408.0204	412.5204
TT	56	415.2500	419.7500	415.2625	419.7625	414.0207	418.5207
UU	57	421.2500	425.7500	421.2625	425.7625	420.0210	424.5210
VV	58	427.2500	431.7500	427.2625	431.7625	426.0213	430.5213
WW	59	433.2500	437.7500	433.2625	437.7625	432.0216	436.5216
XX	60	439.2500	443.7500	439.2625	443.7625	438.0219	442.5219
YY	61	445.2500	449.7500	445.2625	449.7625	444.0222	448.5222
ZZ	62	451.2500	455.7500	451.2625	455.7625	450.0225	454.5225
AAA	63	457.2500	461.7500	457.2625	461.7625	456.0228	460.5228

* Means aeronautical channels visual carrier frequency tolerance ± 5 kHz

Frequency Charts

CATV Channels, North America

	EIA	Standard		Incremental		Harmonic	
CH.	CH.	Video	Audio	Video	Audio	Video	Audio
BBB	64	463.2500	467.7500	463.2625	467.7625	462.0231	466.5231
CCC	65	469.2500	473.7500	469.2625	473.7625	468.0234	472.5234
DDD	66	475.2500	479.7500	475.2625	479.7625	474.0237	478.5237
EEE	67	481.2500	485.7500	481.2625	485.7625	480.0240	484.5240
FFF	68	487.2500	491.7500	487.2625	491.7625	486.0243	490.5243
GGG	69	493.2500	497.7500	493.2625	497.7625	492.0246	496.5246
HHH	70	499.2500	503.7500	499.2625	503.7625	498.0249	502.5249
III	71	505.2500	509.7500	505.2625	509.7625	504.0252	508.5252
JJJ	72	511.2500	515.7500	511.2625	515.7625	510.0255	514.5255
KKK	73	517.2500	521.7500	517.2625	521.7625	516.0258	520.5258
LLL	74	523.2500	527.7500	523.2625	527.7625	522.0261	526.5261
MMM	75	529.2500	533.7500	529.2625	533.7625	528.0264	532.5264
NNN	76	535.2500	539.7500	535.2625	539.7625	534.0267	538.5267
000	77	541.2500	545.7500	541.2625	545.7625	540.0270	544.527C
PPP	78	547.2500	551.7500	547.2625	551.7625	546.0273	550.5273
-	79	553.2500	557.7500	553.2625	557.7625	552.0276	556.5276
-	80	559.2500	563.7500	559.2625	563.7625	558.0279	562.5279
-	81	565.2500	569.7500	565.2625	569.7625	564.0282	568.5282
-	82	571.2500	575.7500	571.2625	575.7625	570.0285	574.5285
-	83	577.2500	581.7500	577.2625	581.7625	576.0288	580.5288
-	84	583.2500	587.7500	583.2625	587.7625	582.0291	586.5291
-	85	589.2500	593.7500	589.2625	593.7625	588.0294	592.5294
-	86	595.2500	599.7500	595.2625	599.7625	594.0297	598.5297
-	87	601.2500	605.7500	601.2625	605.7625	600.0300	604.5300
-	88	607.2500	611.7500	607.2625	611.7625	606.0303	610.5303
-	89	613.2500	617.7500	613.2625	617.7625	612.0306	616.5306
-	90	619.2500	623.7500	619.2625	623.7625	618.0309	622.5309
-	91	625.2500	629.7500	625.2625	629.7625	624.0312	628.5312
-	92	631.2500	635.7500	631.2625	635.7625	630.0315	634.5315
-	93	637.2500	641.7500	637.2625	641.7625	636.0318	640.5318
-	94	643.2500	647.7500	643.2625	647.7625	642.0321	646.5321
-	100	649.2500	653.7500	649.2625	653.7625	648.0324	652.5324
-	101	655.2500	659.7500	655.2625	659.7625	654.0327	658.5327
-	102	661.2500	665.7500	661.2625	665.7625	660.0330	664.5330
-	103	667.2500	671.7500	667.2625	671.7625	666.0333	670.5333
-	104	673.2500	677.7500	673.2625	677.7625	672.0336	676.5336
-	105	679.2500	683.7500	679.2625	683.7625	678.0339	682.5339
-	106	685.2500	689.7500	685.2625	689.7625	684.0342	688.5342

* Means aeronautical channels visual carrier frequency tolerance ± 5 kHz

Frequency Charts

CATV Channels, North America

	EIA	Standard		Incremental		Harmonic	
CH.	CH.	Video	Audio	Video	Audio	Video	Audio
-	107	691.2500	695.7500	691.2625	695.7625	690.0345	694.5345
-	108	697.2500	701.7500	697.2625	701.7625	696.0348	700.5348
-	109	703.2500	707.7500	703.2625	707.7625	702.0351	706.5351
-	110	709.2500	713.7500	709.2625	713.7625	708.0354	712.5354
-	111	715.2500	719.7500	715.2625	719.7625	714.0357	718.5357
-	112	721.2500	725.7500	721.2625	725.7625	720.0360	724.5360
-	113	727.2500	731.7500	727.2625	731.7625	726.0363	730.5363
-	114	733.2500	737.7500	733.2625	737.7625	732.0366	736.5366
-	115	739.2500	743.7500	739.2625	743.7625	738.0369	742.5369
-	116	745.2500	749.7500	745.2625	749.7625	744.0372	748.5372
-	117	751.2500	755.7500	751.2625	755.7625	750.0375	754.5375
-	118	757.2500	761.7500	757.2625	761.7625	756.0378	760.5378
-	119	763.2500	767.7500	763.2625	767.7625	762.0381	766.5381
-	120	769.2500	773.7500	769.2625	773.7625	768.0384	772.5384
-	121	775.2500	779.7500	775.2625	779.7625	774.0387	778.5387
-	122	781.2500	785.7500	781.2625	785.7625	780.0390	784.5390
-	123	787.2500	791.7500	787.2625	791.7625	786.0393	790.5393
-	124	793.2500	797.7500	793.2625	797.7625	792.0396	796.5396
-	125	799.2500	803.7500	799.2625	803.7625	798.0399	802.5399
-	126	805.2500	809.7500	805.2625	809.7625	804.0402	808.5402
-	127	811.2500	815.7500	811.2625	815.7625	810.0405	814.5405
-	128	817.2500	821.7500	817.2625	821.7625	816.0408	820.5408
-	129	823.2500	827.7500	823.2625	827.7625	822.0411	826.5411
-	130	829.2500	833.7500	829.2625	833.7625	828.0414	832.5414
-	131	835.2500	839.7500	835.2625	839.7625	834.0417	838.5417
-	132	841.2500	845.7500	841.2625	845.7625	840.0420	844.5420
-	133	847.2500	851.7500	847.2625	851.7625	846.0423	850.5423
-	134	853.2500	857.7500	853.2625	857.7625	852.0426	856.5426
-	135	859.2500	863.7500	859.2625	863.7625	858.0429	862.5429
-	136	865.2500	869.7500	865.2625	869.7625	864.0432	868.5432
-	137	871.2500	875.7500	871.2625	875.7625	870.0435	874.5435
-	138	877.2500	881.7500	877.2625	881.7625	876.0438	880.5438
-	139	883.2500	887.7500	883.2625	887.7625	882.0441	886.5441
-	140	889.2500	893.7500	889.2625	893.7625	888.0444	892.5444
-	141	895.2500	899.7500	895.2625	899.7625	894.0447	898.5447
-	142	901.2500	905.7500	901.2625	905.7625	900.0450	904.5450
-	143	907.2500	911.7500	907.2625	911.7625	906.0453	910.5453

Frequency Charts

CATV Channels, North America

	EIA	Standard		Incremental		Harmonic	
CH.	CH.	Video	Audio	Video	Audio	Video	Audio
-	144	913.2500	917.7500	913.2625	917.7625	912.0456	916.5456
-	145	919.2500	923.7500	919.2625	923.7625	918.0459	922.5459
-	146	925.2500	929.7500	925.2625	929.7625	924.0462	928.5462
-	147	931.2500	935.7500	931.2625	935.7625	930.0465	934.5465
-	148	937.2500	941.7500	937.2625	941.7625	936.0468	940.5468
-	149	943.2500	947.7500	943.2625	947.7625	942.0471	946.5470
-	150	949.2500	953.7500	949.2625	953.7625	948.0474	952.5474
-	151	955.2500	959.7500	955.2625	959.7625	954.0477	958.5477
-	152	961.2500	965.7500	961.2625	965.7625	960.0480	964.5480
-	153	967.2500	971.7500	967.2625	971.7625	966.0483	970.5483
-	154	973.2500	977.7500	973.2625	977.7625	972.0486	976.5486
-	155	979.2500	983.7500	979.2625	983.7625	978.0489	982.5489
-	156	985.2500	989.7500	985.2625	989.7625	984.0492	988.5492
-	157	991.2500	995.7500	991.2625	995.7625	990.0495	994.5495
-	158	997.2500	1001.7500	997.2625	1001.7625	996.0498	1000.5498

Frequency Charts

CATV QAM Channel Center Frequency - 54 MHz to 860 MHz

EIA CH.	MHz Center Frequency	EIA CH.	MHz Center Frequency	EIA CH.	MHz Center Frequency
2	57	42	333	87	603
3	63	43	339	88	609
4	69	44	345	89	615
5	79	45	351	90	621
6	85	46	357	91	627
95	93	47	363	92	633
96	99	48	369	93	639
97	105	49	375	94	645
98	111	50	381	100	651
99	119	51	387	101	657
14	123	52	393	102	663
15	129	53	399	103	669
16	135	54	405	104	675
17	141	55	411	105	681
18	147	56	417	106	687
19	153	57	423	107	693
20	159	58	429	108	699
21	165	59	435	109	705
22	171	60	441	110	711
7	177	61	447	111	717
8	183	62	453	112	723
9	189	63	459	113	729
10	195	64	465	114	735
11	201	65	471	115	741
12	207	66	477	116	747
13	213	67	483	117	753
23	219	68	489	118	759
24	225	69	495	119	765
25	231	70	501	120	771
26	237	71	507	121	777
27	243	72	513	122	783
28	249	73	519	123	789
29	255	74	525	124	795
30	261	75	531	125	801
31	267	76	537	126	807
32	273	77	543	127	813
33	279	78	549	128	819
34	285	79	555	129	825
35	291	80	561	130	831
36	297	81	567	131	837
37	303	82	573	132	843
38	309	83	579	133	849
39	315	84	585	134	855
40	321	85	591	135	861
41	327	86	597		

Frequency Charts

Off Air Channels, North America (CCIR Standard M; NTSC)

CH.	BW (MHz)	VIDEO	CHROMA	AUDIO
Lo VHF				
2	54-60	55.25	58.83	59.75
3	60-66	61.25	64.83	65.75
4	66-72	67.25	70.83	71.75
5	76-82	77.25	80.83	81.75
6	82-88	83.25	86.83	87.75
Hi VHF				
7	174-180	175.25	178.83	179.75
8	180-186	181.25	184.83	185.75
9	186-192	187.25	190.83	191.75
10	192-198	193.25	196.83	197.75
11	198-204	199.25	202.83	203.75
12	204-210	205.25	208.83	209.75
13	210-216	211.25	214.83	215.75
UHF				
14	470-476	471.25	474.83	475.75
15	476-482	477.25	480.83	481.75
16	482-488	483.25	486.83	487.75
17	488-494	489.25	492.83	493.75
18	494-500	495.25	498.83	499.75
19	500-506	501.25	504.83	505.75
20	506-512	507.25	510.83	511.75
21	512-518	513.25	516.83	517.75
22	518-524	519.25	522.83	523.75
23	524-530	525.25	528.83	529.75
24	530-536	531.25	534.83	535.75
25	536-542	537.25	540.83	541.75
26	542-548	543.25	546.83	547.75
27	548-554	549.25	552.83	553.75
28	554-560	555.25	558.83	559.75
29	560-566	561.25	564.83	565.75
30	566-572	567.25	570.83	571.75
31	572-578	573.25	576.83	577.75
32	578-584	579.25	582.83	583.75
33	584-590	585.25	588.83	589.75
34	590-596	591.25	594.83	595.75
35	596-602	597.25	600.83	601.75
36	602-608	603.25	606.83	607.75
37	608-614	609.25	612.83	613 75
38	614-620	615.25	618.83	619.75

Frequency Charts

Off Air Channels, North America (CCIR Standard M; NTSC)

CH.	BW (MHz)	VIDEO	CHROMA	AUDIO
UHF				
39	620-626	621.25	624.83	625.75
40	626-632	627.25	630.83	631.75
41	632-638	633.25	636.83	637.75
42	638-644	639.25	642.83	643.75
43	644-650	645.25	648.83	649.75
44	650-656	651.25	654.83	655.75
45	656-662	657.25	660.83	661.75
46	662-668	663.25	666.83	667.75
47	668-674	669.25	672.83	673.75
48	674-680	675.25	678.83	679.75
49	680-686	681.25	684.83	685.75
50	686-692	687.25	690.83	691.75
51	692-698	693.25	696.83	697.75
52	698-704	699.25	702.83	703.75
53	704-710	705.25	708.83	709.75
54	710-716	711.25	714.83	715.75
55	716-722	717.25	720.83	721.75
56	722-728	723.25	726.83	727.75
57	728-734	729.25	732.83	733.75
58	734-740	735.25	738.83	739.75
59	740-746	741.25	744.83	745.75
60	746-752	747.25	750.83	751.75

PAL B Channels

Band	Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
IF	IF	IF	38.90	33.40
I	E2	02	48.25	53.75
I	E3	03	55.25	60.75
I	E4	04	62.25	67.75
L	S1	S01	105.25	110.75
L	S2	S02	112.25	117.75
L	S3	S03	119.25	124.75
L	S4	S04	126.25	131.75
L	S5	S05	133.25	138.75
L	S6	S06	140.25	145.75
L	S7	S07	147.25	152.75
L	S8	S08	154.25	159.75
L	S9	S09	161.25	166.75
L	S10	S10	168.25	173.75
III	E5	05	175.25	180.75
III	E6	06	182.25	187.75
III	E7	07	189.25	194.75
III	E8	08	196.25	201.75
III	E9	09	203.25	208.75
III	E10	10	210.25	215.75
III	E11	11	217.25	222.75
III	E12	12	224.25	229.75
U	S11	S11	231.25	236.75
U	S12	S12	238.25	243.75
U	S13	S13	245.25	250.75
U	S14	S14	252.25	257.75
U	S15	S15	259.25	264.75
U	S16	S16	266.25	271.75
U	S17	S17	273.25	278.75
U	S18	S18	280.25	285.75
U	S19	S19	287.25	292.75
U	S20	S20	294.25	299.75
U	S21	S21	303.25	308.75
U	S22	S22	311.25	316.75
U	S23	S23	319.25	324.75
U	S24	S24	327.25	332.75

PAL B Channels

Band	Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
U	S25	S25	335.25	340.75
U	S26	S26	343.25	348.75
U	S27	S27	351.25	356.75
U	S28	S28	359.25	364.75
U	S29	S29	367.25	372.75
U	S30	S30	375.25	380.75
U	S31	S31	383.25	388.75
U	S32	S32	391.25	396.75
U	S33	S33	399.25	404.75
U	S34	S34	407.25	412.75
U	S35	S35	415.25	420.75
U	S36	S36	423.25	428.75
U	S37	S37	431.25	436.75
U	S38	S38	439.25	444.75
U	S39	S39	447.25	452.75
U	S40	S40	455.25	460.75
U	S41	S41	463.25	468.75

PAL G Channels

Band	Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
IV	21	U21	471.25	476.75
IV	22	U22	479.25	484.75
IV	23	U23	487.25	492.75
IV	24	U24	495.25	500.75
IV	25	U25	503.25	508.75
IV	26	U26	511.25	516.75
IV	27	U27	519.25	524.75
IV	28	U28	527.25	532.75
IV	29	U29	535.25	540.75
IV	30	U30	543.25	548.75
IV	31	U31	551.25	556.75
IV	32	U32	559.25	564.75
IV	33	U33	567.25	572.75
IV	34	U34	575.25	580.75
IV	35	U35	583.25	588.75
IV	36	U36	591.25	596.75
IV	37	U37	599.25	604.75
V	38	U38	607.25	612.75
V	39	U39	615.25	620.75
V	40	U40	623.25	628.75
V	41	U41	631.25	636.75
V	42	U42	639.25	644.75
V	43	U43	647.25	652.75
V	44	U44	655.25	660.75
V	45	U45	663.25	668.75
V	46	U46	671.25	676.75
V	47	U47	679.25	684.75
V	48	U48	687.25	692.75
V	49	U49	695.25	700.75

PAL G Channels

Band	Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
V	50	U50	703.25	708.75
V	51	U51	711.25	716.75
V	52	U52	719.25	724.75
V	53	U53	727.25	732.75
V	54	U54	735.25	740.75
V	55	U55	743.25	748.75
V	56	U56	751.25	756.75
V	57	U57	759.25	764.75
V	58	U58	767.25	772.75
V	59	U59	775.25	780.75
V	60	U60	783.25	788.75
V	61	U61	791.25	796.75
V	62	U62	799.25	804.75
V	63	U63	807.25	812.75
V	64	U64	815.25	820.75
V	65	U65	823.25	828.75
V	66	U66	831.25	836.75
V	67	U67	839.25	844.75
V	68	U68	847.25	852.75
V	69	U69	855.25	860.75

PAL D Channels

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
IF	IF	38.00	31.50
DS-1	01	49.75	56.25
DS-2	02	57.75	64.25
DS-3	03	65.75	72.25
DS-4	04	77.25	83.75
DS-5	05	85.25	91.75
Z-1	Z01	112.25	118.75
Z-2	Z02	120.25	126.75
Z-3	Z03	128.25	134.75
Z-4	Z04	136.25	142.75
Z-5	Z05	144.25	150.75
Z-6	Z06	152.25	158.75
Z-7	Z07	160.25	166.75
DS-6	06	168.25	174.75
DS-7	07	176.25	182.75
DS-8	08	184.25	190.75
DS-9	09	192.25	198.75
DS-10	10	200.25	206.75
DS-11	11	208.25	214.75
DS-12	12	216.25	222.75
Z-8	Z08	224.25	230.75
Z-9	Z09	232.25	238.75
Z-10	Z10	240.25	246.75
Z-11	Z11	248.25	254.75
Z-12	Z12	256.25	262.75
Z-13	Z13	264.25	270.75
Z-14	Z14	272.25	278.75
Z-15	Z15	280.25	286.75

PAL D Channels

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
Z-16	Z16	288.25	294.75
Z-17	Z17	296.25	302.75
Z-18	Z18	304.25	310.75
Z-19	Z19	312.25	318.75
Z-20	Z20	320.25	326.75
Z-21	Z21	328.25	334.75
Z-22	Z22	336.25	342.75
Z-23	Z23	344.25	350.75
Z-24	Z24	352.25	358.75
Z-25	Z25	360.25	366.75
Z-26	Z26	368.25	374.75
Z-27	Z27	376.25	382.75
Z-28	Z28	384.25	390.75
Z-29	Z29	392.25	398.75
Z-30	Z30	400.25	406.75
Z-31	Z31	408.25	414.75
Z-32	Z32	416.25	422.75
Z-33	Z33	424.25	430.75
Z-34	Z34	432.25	438.75
Z-35	Z35	440.25	446.75
Z-36	Z36	448.25	454.75

PAL K Channels

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
IF	IF	38.00	31.50
DS-13	U13	471.25	477.75
DS-14	U14	479.25	485.75
DS-15	U15	487.25	493.75
DS-16	U16	495.25	501.75
DS-17	U17	503.25	509.75
DS-18	U18	511.25	517.75
DS-19	U19	519.25	525.75
DS-20	U20	527.25	533.75
DS-21	U21	535.25	541.75
DS-22	U22	543.25	549.75
DS-23	U23	551.25	557.75
DS-24	U24	559.25	565.75
DS-25	U25	607.25	613.75
DS-26	U26	615.25	621.75
DS-27	U27	623.25	629.75
DS-28	U28	631.25	637.75
DS-29	U29	639.25	645.75
DS-30	U30	647.25	653.75
DS-31	U31	655.25	661.75
DS-32	U32	663.25	669.75
DS-33	U33	671.25	677.75
DS-34	U34	679.25	685.75
DS-35	U35	687.25	693.75
DS-36	U36	695.25	701.75
DS-37	U37	703.25	709.75
DS-38	U38	711.25	717.75

PAL K Channels

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency MHz	Aural Carrier Frequency MHz
DS-39	U39	719.25	725.75
DS-40	U40	727.25	733.75
DS-41	U41	735.25	741.75
DS-42	U42	743.25	749.75
DS-43	U43	751.25	757.75
DS-44	U44	759.25	765.75
DS-45	U45	767.25	773.75
DS-46	U46	775.25	781.75
DS-47	U47	783.25	789.75
DS-48	U48	791.25	797.75
DS-49	U49	799.25	805.75
DS-50	U50	807.25	813.75
DS-51	U51	815.25	821.75
DS-52	U52	823.25	829.75
DS-53	U53	831.25	837.75
DS-54	U54	839.25	845.75
DS-55	U55	847.25	853.75
DS-56	U56	855.25	861.75

PAL I Channels

HRC

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency (MHz)	Aural Carrier Frequency (MHz)
IF	IF	38.90	32.90
1	01	56.00	62.00
2	02	64.00	70.00
3	03	72.00	78.00
4	04	80.00	86.00
5	05	88.00	94.00
6	06	96.00	102.00
7	07	104.00	110.00
8	08	112.00	118.00
9	09	120.00	126.00
10	10	128.00	134.00
11	11	136.00	142.00
12	12	144.00	150.00
13	13	152.00	158.00
14	14	160.00	166.00
15	15	168.00	174.00
16	16	176.00	182.00
17	17	184.00	190.00
18	18	192.00	198.00
19	19	200.00	206.00
20	20	208.00	214.00
21	21	216.00	222.00
22	22	224.00	230.00
23	23	232.00	238.00
24	24	240.00	246.00
25	25	248.00	254.00
26	26	256.00	262.00
27	27	264.00	270.00
28	28	272.00	278.00
29	29	280.00	286.00
30	30	288.00	294.00
31	31	296.00	302.00
32	32	304.00	310.00
33	33	312.00	318.00
34	34	320.00	326.00
35	35	328.00	334.00

PAL I Channels

HRC

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency (MHz)	Aural Carrier Frequency (MHz)
36	36	336.00	342.00
37	37	344.00	350.00
38	38	352.00	358.00
39	39	360.00	366.00
40	40	368.00	374.00
41	41	376.00	382.00
42	42	384.00	390.00
43	43	392.00	398.00
44	44	400.00	406.00
45	45	408.00	414.00
46	46	416.00	422.00
47	47	424.00	430.00
48	48	432.00	438.00
49	49	440.00	446.00
50	50	448.00	454.00
51	51	456.00	462.00
52	52	464.00	470.00
53	53	472.00	478.00
54	54	480.00	486.00
55	55	488.00	494.00
56	56	596.00	502.00
57	57	504.00	510.00
58	58	512.00	518.00
59	59	520.00	526.00
60	60	528.00	534.00
61	61	536.00	542.00
62	62	544.00	550.00
63	63	552.00	558.00
64	64	560.00	566.00
65	65	568.00	574.00
66	66	576.00	582.00
67	67	584.00	590.00
68	68	592.00	598.00

PAL I Channels

UHF

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency (MHz)	Aural Carrier Frequency (MHz)
IF	IF	38.00	31.50
21	U21	471.25	477.25
22	U22	479.25	485.25
23	U23	487.25	493.25
24	U24	495.25	501.25
25	U25	503.25	509.25
26	U26	511.25	517.25
27	U27	519.25	525.25
28	U28	527.25	533.25
29	U29	535.25	541.25
30	U30	543.25	549.25
31	U31	551.25	557.25
32	U32	559.25	565.25
33	U33	567.25	573.25
34	U34	575.25	581.25
35	U35	583.25	589.25
36	U36	591.25	597.25
37	U37	599.25	605.25
38	U38	607.25	613.25
39	U39	615.25	621.25
40	U40	623.25	629.25
41	U41	631.25	637.25
42	U42	639.25	645.25
43	U43	647.25	653.25
44	U44	655.25	661.25
45	U45	663.25	669.25
46	U46	671.25	677.25
47	U47	679.25	685.25
48	U48	687.25	693.25
49	U49	695.25	701.25
50	U50	703.25	709.25
51	U51	711.25	717.25
52	U52	719.25	725.25

PAL I Channels

UHF

Channel Designation Standard	Channel Designation Ordering	Visual Carrier Frequency (MHz)	Aural Carrier Frequency (MHz)
53	U53	727.25	733.25
54	U54	735.25	741.25
55	U55	743.25	749.25
56	U56	751.25	757.25
57	U57	759.25	765.25
58	U58	767.25	773.25
59	U59	775.25	781.25
60	U60	783.25	789.25
61	U61	791.25	797.25
62	U62	799.25	805.25
63	U63	807.25	813.25
64	U64	815.25	821.25
65	U65	823.25	829.25
66	U66	831.25	837.25
67	U67	839.25	845.25
68	U68	847.25	853.25
69	U69	855.25	861.25

FM Broadcast Channel Frequencies (MHz)

Channel	Frequency	Channel	Frequency	Channel	Frequency
1	88.1	35	94.9	69	101.7
2	88.3	36	95.1	70	101.9
3	88.5	37	95.3	71	102.1
4	88.7	38	95.5	72	102.3
5	88.9	39	95.7	73	102.5
6	89.1	40	95.9	74	102.7
7	89.3	41	96.1	75	102.9
8	89.5	42	96.3	76	103.1
9	89.7	43	96.5	77	103.3
10	89.9	44	96.7	78	103.5
11	90.1	45	96.9	79	103.7
12	90.3	46	97.1	80	1039
13	90.5	47	97.3	81	104.1
14	90.7	48	97.5	82	104.3
15	90.9	49	97.7	83	104.5
16	91.1	50	97.9	84	104.7
17	91.3	51	98.1	85	104.9
18	91.5	52	98.3	86	105.1
19	91.7	53	98.5	87	105.3
20	91.9	54	98.7	88	105.5
21	92.1	55	98.9	89	105.7
22	92.3	56	99.1	90	105.9
23	92.5	57	99.3	91	106 1
24	92.7	58	99.5	92	1063
25	92.9	59	99.7	93	106.5
26	93.1	60	99.9	94	106.7
27	93.3	61	100.1	95	106.9
28	93.5	62	100.3	96	107.1
29	93.7	63	100.5	97	107.3
30	93.9	64	100.7	98	107.5
31	94.1	65	100.9	99	107.7
32	94.3	66	101.1	100	107.9
33	94.5	67	101.3		
34	94.7	68	101.5		

International Channel Standards

Country	Color System	Broadcast Standard		Channel Frequencies
		VHF	UHF	
Argentina	PAL	N	N	Amer
Australia	PAL	B	G	Australian
Austria	PAL	B	G	West Euro
Bahamas	NTSC	M		Amer
Belgium	PAL	B	H	West Euro
Bermuda	NTSC	M		Amer
Bolivia	NTSC	M	M	Amer
Brazil	PAL	M	M	Amer
Canada	NTSC	M	M	Amer
Chile	NTSC	M		Amer
China	PAL	D		Chinese
China, Rep	NTSC	M		Amer
Colombia	NTSC	M	M	Amer
Costa Rica	NTSC	M		Amer
Denmark	PAL	B	G	West Euro
Ecuador	NTSC	M		Amer
Egypt	SECAM	B		West Euro
Finland	PAL	B	G	West Euro
France	SECAM	L	L	French
Germany	SECAM/PAL	B	G	West Euro
Greece	SECAM	B	G	West Euro
Hong Kong	PAL		I	West Euro
Hungary	SECAM	D	K	East Euro
Hungary	SECAM	D	K	East Euro
India	PAL	B		West Euro
Indonesia	PAL	B		West Euro
Iran	SECAM	B	G	West Euro
Iraq	SECAM	B		West Euro
Ireland	PAL	A	I	Irish

International Channel Standards

Country	Color System	Broadcast Standard		Channel Frequencies
		VHF	UHF	
Israel	PAL	B	G	West Euro
Italy	PAL	B	G	Italian
Japan	W	M	M	JPN
Jordan	PAL	B	G	West Euro
Korea S.	NTSC	M	M	Amer
Malaysia	PAL	B	G	West Euro
Mexico	NTSC	M	M	Amer
Morocco	SECAM	B		Morocco
Netherlands	PAL	B	G	West Euro
New Zealand	PAL	B	G	NZ
Norway	PAL	B	G	West Euro
Panama	NTSC	M	M	Amer
Peru	NTSC	M	M	Amer
Philippines	NTSC	M		Amer
Poland	SECAM	D	K	East Euro
Portugal	PAL	B	G	West Euro
Romania	SECAM	D	K	East Euro
Russia	SECAM	D	K	East Euro
Singapore	PAL	B	G	West Euro
Spain	PAL	B	G	West Euro
Sweden	PAL	B	G	West Euro
Switzerland	PAL	B	G	West Euro
United King.	PAL	I	I	West Euro
Uruguay	PAL	N		Amer
USA	NTSC	M	M	Amer
Venezuela	NTSC	M		Amer

CCIR Television Transmission Characteristics

For Off Air Channels

SYSTEM	LINES Freq. (Hz)	FIELD Freq. (MHz)	LINE Width (MHz)	CHAN. B/W (MHz)	VIDEO Spacing (MHz)	VID/SND Sideb (MHz)	VEST MOD	VISUAL MOD	AURAL
B/G	625	50	15,625	7/8	5	+ 5.5	0.75	NEG	FM
C	625	50	15,625	7	5	+ 5.5	0.75	POS	AM
D/K	625	50	15,625	8	6	+6.5	0.75	NEG	FM
H	625	50	15,625	8	5	+ 5.5	1.25	NEG	FM
I	625	50	15,625	8	5.5	+ 6.0	1.25	NEG	FM
K1	625	50	15,625	8	6	+ 6.5	1.25	NEG	FM
L	525	50	15,625	8	6	+/- 6.5	1.25	POS	AM
M	525	60	15,734	6	4.2	+ 4 5	0.75	NEG	FM
N	625	50	15,625	6	4.2	+ 4.5	0.75	NEG	FM

CCIR: Commité Consulatif International Radiocommunications

NTSC: National Television Systems Committee
"Never Twice the Same Color"

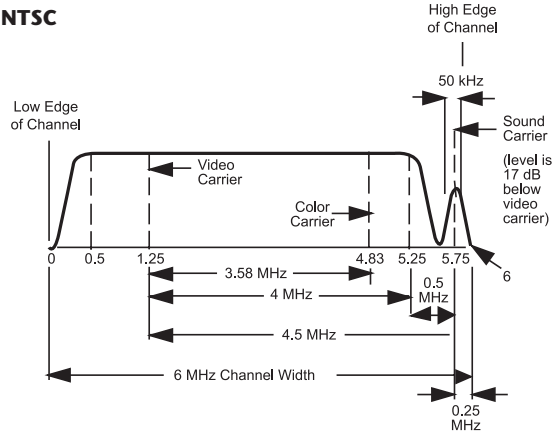
PAL: Phase Alternating Lines
"Pay for Additional Luxury"

SECAM: Sequential Color with Memory (Sequentiel Couleur Avec Memoire)
"System Essentially Contrary to the American Method"

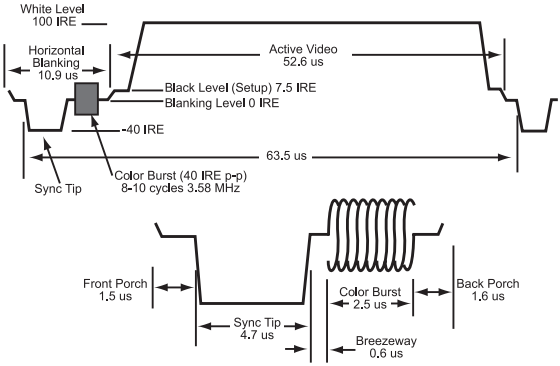
OIRT: Organisation Internationale Radiodiffusion - Television

Cable TV Channel Format

NTSC



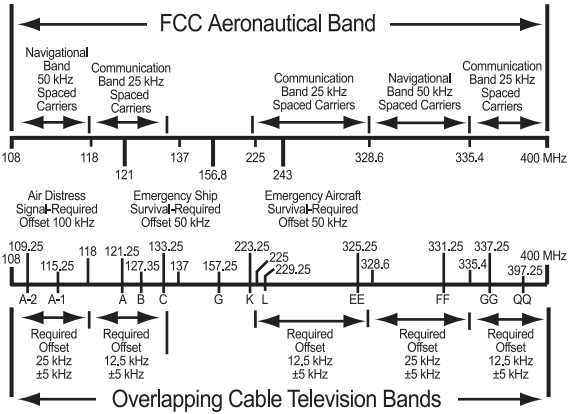
NTSC Composite Video Waveform



US Frequency Spectrum

FCC Aeronautical Band Frequencies

Used for Communication and Navigation



North American Satellite C & Ku-Band

61.5° W	EchoStar 3
	Rainbow 1
63.0° W	Estrela do Sul 1
65.0° W	Star One C1
70.0° W	Star One C2
72.0° W	Nahuel 1 (incl. 0.9°)
	AMC 6
72.5° W	DirecTV 1R
74.0° W	Horizons 2
75.0° W	Brasilsat B1 (incl. 1.3°)
76.8° W	Galaxy 4R (incl. 1.8°)
77.0° W	EchoStar 4 (incl. 0.7°)
79.0° W	AMC 5
80.9° W	SBS 6 (incl. 0.9°)
82.0° W	Nimiq 2
83.0° W	Brasilsat B4 (moves 0.5°W/day)
83.0° W	AMC 9
84.0° W	Brasilsat B3
85.0° W	AMC 16
85.1° W	XM 3
87.0° W	AMC 3
89.0° W	Galaxy 28
91.0° W	Galaxy 11
	Nimiq 1
92.0° W	Brasilsat B2
93.0° W	Galaxy 26
95.0° W	Galaxy 3C
95.0° W	Spaceway 3
97.0° W	Galaxy 25
99.0° W	Galaxy 16
99.2° W	Spaceway 2
100.7° W	DirecTV 11
101.0° W	AMC 2
	AMC 4
	DirecTV 4S/8

101.1° W	DirecTV 9S
102.8° W	Spaceway 1
	DirecTV 10
103.0° W	AMC 1
105.0° W	AMC 15
	AMC 18
107.3° W	Anik F1
	Anik F1R
110.0° W	DirecTV 5
	EchoStar 8
	EchoStar 10
111.1° W	Anik F2
112.0° W	Galaxy 17 (moving 1.7°E/day)
113.0° W	SatMex 6
114.9° W	Solidaridad 2
115.0° W	XM 4
116.8° W	SatMex 5
119.0° W	Anik F3
	EchoStar 7
	DirecTV 7S
121.0° W	EchoStar 9/Galaxy 23
123.0° W	Galaxy 18
125.0° W	Galaxy 14
127.0° W	Galaxy 13/Horizons 1
129.0° W	EchoStar 5
	Galaxy 27
131.0° W	AMC 11
133.0° W	Galaxy 15
135.0° W	AMC 10
137.0° W	AMC 7
139.0° W	AMC 8
148.0° W	EchoStar 1
	EchoStar 2

For up to date info visit http://www.lyngsat.com/america.html

Programming Services

DISH Network™
Video/Audio Programming Service

EchoStar I = 148° W, 15 DBS Transponders
EchoStar II = 148° W, 10 DBS Transponders
EchoStar III = 61.5° W, 14 DBS Transponders
EchoStar IV = 77° W, Not in Services
EchoStar V = 129° W, 20 DBS Transponders
EchoStar VII = 119° W, 21 DBS Transponders
EchoStar VIII = 110° W, 19 DBS Transponders
EchoStar IX = 121° W, 15 Ku & 2 Ka Transponders
EchoStar X = 110° W, 10 DBS Transponders
Rainbow 1 = 61.5° W, 7 DBS Transponders

Dish Network Programming changes frequently.
Please visit http://www.lyngsat.com for the latest information.

Programming Services

DirecTV®

Video/Audio Programming Services

DirecTV 1R = 72.5° W, 15 Transponders
DirecTV 4S = 101.0° W, 32 Transponders
DirecTV 5 = 109.8° W, 3 Transponders
DirecTV 7S = 119.0° W, 8 Transponders
DirectTV 10 = 102.8° W, 17 Ka Transponders
Spaceway-1 = 102.8° W, 6 Ka Transponders
Spaceway-2 = 99.2° W, 48 Ka Transponders
DirecTV 9S = 101.1° W
DirecTV 11 = 100.7° W

DirecTV Programming changes frequently.
Please visit http://www.lyngsat.com for the latest information.

Bell ExpressVu™

Video/Audio Programming Services

Nimiq 1 = 91° W, 32 Transponders
Nimiq 2 = 82° W, 32 Transponders

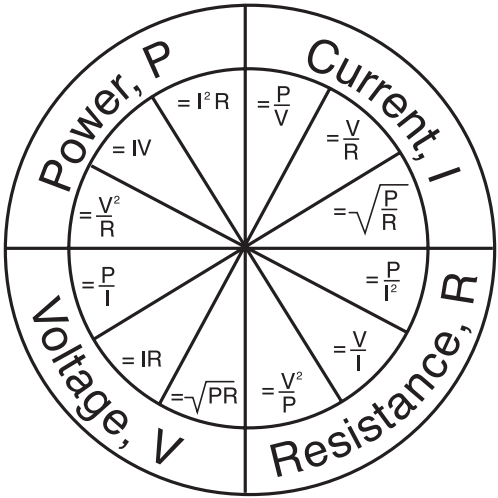
Bell ExpressVu Programming changes frequently.
Please visit http://www.lyngsat.com for the latest information.

Conversion Factors

Ohm's Law & Joule's Law

Ohm's Law V = IR	Joule's Law P = IV
V = voltage in volts	P = power in watts
I = current in amperes	I = current in amperes
R = resistance in ohms	V = voltage in volts

Equations Summary of Ohm's & Joule's Laws



Ohms Law (1863)

A Law in Electricity: the strength of a direct current is directly proportional to the potential difference and inversely proportional to the resistance of the circuit (Georg Simon Ohm - 1870)

Table of Conversions

The following table lists the conversions between voltage and power measurements for the range of signal levels commonly encountered in Broadband networks. The equations described on pages 87, 88 and 89 were used in the compilation of this table.

mV	dBmV	dBµV	dBm
0.0010	-60	0	-108.75
0.0011	-59	1	-107.75
0.0013	-58	2	-106.75
0.0014	-57	3	-105.75
0.0016	-56	4	-104.75
0.0018	-55	5	-103.75
0.0020	-54	6	-102.75
0.0022	-53	7	-101.75
0.0025	-52	8	-100.75
0.0028	-51	9	-99.75
0.0032	-50	10	-98.75
0.0035	-49	11	-97.75
0.0040	-48	12	-96.75
0.0045	-47	13	-95.75
0.0050	-46	14	-94.75
0.0056	-45	15	-93.75
0.0063	-44	16	-92.75
0.0071	-43	17	-91.75
0.0079	-42	18	-90.75
0.0089	-41	19	-89.75
0.0100	-40	20	-88.75
0.0112	-39	21	-87.75
0.0126	-38	22	-86.75
0.0141	-37	23	-85.75
0.0158	-36	24	-84.75
0.0178	-35	25	-83.75
0.0200	-34	26	-82.75
0.0224	-33	27	-81.75
0.0251	-32	28	-80.75
0.0282	-31	29	-79.75
0.0316	-30	30	-78.75
0.0355	-29	31	-77.75
0.0398	-28	32	-76.75
0.0447	-27	33	-75.75
0.0501	-26	34	-74.75
0.0562	-25	35	-73.75
0.0631	-24	36	-72.75
0.0708	-23	37	-71.75
0.0794	-22	38	-70.75
0.0891	-21	39	-69.75
0.1000	-20	40	-68.75
0.1122	-19	41	-67.75
0.1259	-18	42	-66.75
0.1413	-17	43	-65.75
0.1585	-16	44	-64.75
0.1778	-15	45	-63.75
0.1995	-14	46	-62.75
0.2239	-13	47	-61.75
0.2512	-12	48	-60.75
0.2818	-11	49	-59.75
0.3162	-10	50	-58.75
0.3548	-9	51	-57.75
0.3981	-8	52	-56.75
0.4467	-7	53	-55.75
0.5012	-6	54	-54.75
0.5623	-5	55	-53.75
0.6310	-4	56	-52.75
0.7079	-3	57	-51.75
0.7943	-2	58	-50.75
0.8913	-1	59	-49.75
1.0000	0	60	-48.75
1.1220	1	61	-47.75
1.2589	2	62	-46.75
1.4125	3	63	-45.75
1.5849	4	64	-44.75
1.7783	5	65	-43.75

Table of Conversions

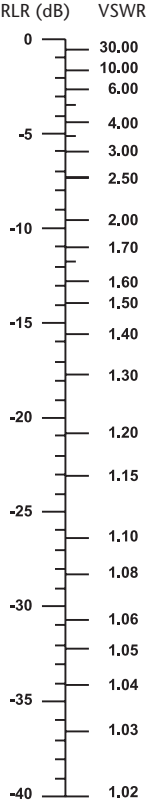
mV	dBmV	dbµV	dBm
1.9953	6	66	-42.75
2.2387	7	67	-41.75
2.5119	8	68	-40.75
2.8184	9	69	-39.75
3.1623	10	70	-38.75
3.5481	11	71	-37.75
3.9811	12	72	-36.75
4.4668	13	73	-35.75
5.0119	14	74	-34.75
5.6234	15	75	-33.75
6.3096	16	76	-32.75
7.0795	17	77	-31.75
7.9433	18	78	-30.75
8.9125	19	79	-29.75
10.0000	20	80	-28.75
11.2202	21	81	-27.75
12.5893	22	82	-26.75
14.1254	23	83	-25.75
15.8489	24	84	-24.75
17.7828	25	85	-23.75
19.9526	26	86	-22.75
22.3872	27	87	-21.75
25.1189	28	88	-20.75
28.1838	29	89	-19.75
31.6228	30	90	-18.75
35.4813	31	91	-17.75
39.8107	32	92	-16.75
44.6684	33	93	-15.75
50.1187	34	94	-14.75
56.2341	35	95	-13.75
63.0957	36	96	-12.75
70.7946	37	97	-11.75
79.4328	38	98	-10.75
89.1251	39	99	-9.75
100.0000	40	100	-8.75
112.2018	41	101	-7.75
125.8925	42	102	-6.75
141.2538	43	103	-5.75

mV	dBmV	dbµV	dBm
158.4893	44	104	-4.75
177.8279	45	105	-3.75
199.5262	46	106	-2.75
223.8721	47	107	-1.75
251.1886	48	108	-0.75
273.8420	48.75	108.75	0
281.8383	49	109	0.25
316.2278	50	110	1.25
354.8134	51	111	2.25
398.1072	52	112	3.25
446.6836	53	113	4.25
501.1872	54	114	5.25
562.3413	55	115	6.25
630.9573	56	116	7.25
707.9458	57	117	8.25
794.3282	58	118	9.25
891.2509	59	119	10.25
1000.0000	60	120	11.25
1122.0185	61	121	12.25
1258.9254	62	122	13.25
1412.5375	63	123	14.25
1584.8932	64	124	15.25
1778.2794	65	125	16.25
1995.2623	66	126	17.25
2238.7211	67	127	18.25
2511.8864	68	128	19.25
2818.3829	69	129	20.25
3162.2777	70	130	21.25
3548.1339	71	131	22.25
3981.0717	72	132	23.25
4466.8359	73	133	24.25
5011.8723	74	134	25.25
5623.4133	75	135	26.25
6309.5734	76	136	27.25
7079.4578	77	137	28.25
7943.2823	78	138	29.25
8912.5094	79	139	30.25
10000.0000	80	140	31.25

Return Loss, Reflection Coefficient, and Voltage Standing Wave Ratio (VSWR)

Return Loss (dB)	Loss Reflec.	Reflec. Coefficient (%)	VSWR	Return Loss (dB)	Reflec. Coefficient (%)	VSWR
0.0	4.3	100.00		20.0	10.00	1.222
0.5	2.2	94.41	34.753	20.5	9.44	1.208
1.0	1.26	89.13	17.391	21.0	8.91	1.196
1.5	.74	84.14	11.610	21.5	8.41	1.184
2.0	.45	79.43	8.724	22.0	7.94	1.173
2.5	.28	74.99	6.997	22.5	7.50	1.162
3.0	.17	70.79	5.848	23.0	7.08	1.152
3.5	.11	66.83	5.030	23.5	6.68	1.143
4.0	.07	63.10	4.419	24.0	6.31	1.135
4.5	.04	59.57	3.946	24.5	5.96	1.127
5.0		56.23	3.570	25.0	5.62	1.119
5.5		53.09	3.263	25.5	5.31	1.112
6.0		50.12	3.010	26.0	5.01	1.106
6.5		47.32	2.796	26.5	4.73	1.099
7.0		44.67	2.615	27.0	4.47	1.094
7.5		42.17	2.458	27.5	4.22	1.088
8.0		39.81	2.323	28.0	3.98	1.083
8.5		37.58	2.204	28.5	3.76	1.078
9.0		35.48	2.100	29.0	3.55	1.074
9.5		33.50	2.007	29.5	3.35	1.069
10.0		31.62	1.925	30.0	3.16	1.065
10.5		29.85	1.851	30.5	2.99	1.062
11.0		28.18	1.785	31.0	2.82	1.058
11.5		26.61	1.725	31.5	2.66	1.055
12.0		25.12	1.671	32.0	2.51	1.052
12.5		23.71	1.622	32.5	2.37	1.049
13.0		22.39	1.577	33.0	2.24	1.046
13.5		21.13	1.536	33.5	2.11	1.043
14.0		19.95	1.499	34.0	2.00	1.041
14.5		18.84	1.464	34.5	1.88	1.038
15.0		17.78	1.433	35.0	1.78	1.036
15.5		16.79	1.404	35.5	1.68	1.034
16.0		15.85	1.377	36.0	1.58	1.032
16.5		14.96	1.352	36.5	1.50	1.030
17.0		14.13	1.329	37.0	1.41	1.029
17.5		13.34	1.308	37.5	1.33	1.027
18.0		12.59	1.288	38.0	1.26	1.025
18.5		11.89	1.270	38.5	1.19	1.024
19.0		11.22	1.253	39.0	1.12	1.023
19.5		10.59	1.237	39.5	1.06	1.021

Return Loss Ratio (RLR)



$$RLR\ (dB) = -20 \cdot \log_{10} \frac{(SWR - 1)}{(SWR + 1)}$$

$$RLR\ (dB) = -20 \cdot \log_{10} \left(\frac{\%\ Reflection}{100}\right)$$

$$RLR\ (dB) = -20 \cdot \log_{10} \frac{Z_{75} + Z_x}{Z_{75} - Z_x}\ \text{(see note)}$$

$$\%\ Reflection = \frac{(SWR - 1)}{(SWR + 1)} \cdot 100$$

$$Loss\ (Reflection) = 10 \cdot \log \frac{(VSWR + 1)^2}{4(VSWR)}$$

The column marked Loss Reflec., on page 137 indicates the insertion loss that is attributable to the amount of signal reflected at the device input.

$$SWR = \frac{E_{max}}{E_{min}} \qquad SWR = \frac{10^{\frac{RL}{20}} + 1}{10^{\frac{RL}{20}} - 1}$$

Note: In a 75-Ohm transmission line.

Conversion Factors

Signal Levels

0 dBm	=	+ 48.75 dBmV /75 ohms
0 dBW	=	+ 78.75 dBmV /75 ohms
0 dBmV	=	60 dBµV

Prefixes

milli (m)	=	1/1,000
micro (µ)	=	1/1,000,000
nano (n)	=	1/1,000,000,000
pica (p)	=	1/1,000,000,000,000
kilo (k)	=	1,000
mega (M)	=	1,000,000
giga (G)	=	1,000,000,000

Energy/Heat

12,000 BTU	=	One Ton
1 Watt / hour	=	3.415 Btu
1 horsepower	=	746 Watts
1 atmosphere	=	14.6 pounds per square inch
°Fahrenheit	=	(9/5 x °C) + 32
°CELSIUS	=	5/9 x (°F - 32)

Conversion Factors

Volume

1 cubic yard	=	27 cubic feet
1 cubic inch	=	16.38716 cubic centimeters
1 cubic meter	=	1.307943 cubic yards
1 US gallon	=	3.7853 liters
1 US gallon	=	128 fluid ounces
1 US gallon	=	0.8327 Imperial Gallons
1 liter	=	61.025 cubic inches
1 liter	=	1000 cubic centimeters

Weight

1 pound	=	16 ounces
1 pound	=	453.592 grams
1 kilogram	=	2.20462 pounds
1 kilogram	=	1000 grams
1 ton	=	2000 pounds
1 ton	=	907.185 kilograms
1 metric ton	=	2205 pounds

Conversion Factors

Linear

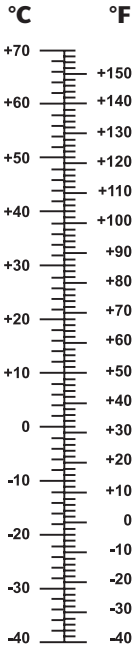
1 mile	=	5280 feet
1 mile	=	1.60935 kilometers
1 kilometer	=	3280.83 feet
1 kilometer	=	0.621 miles
1 kilometer	=	1000 meters
1 meter	=	39.37 inches
1 meter	=	3.281 feet
1 meter	=	100 centimeters
1 centimeter	=	10 millimeters
1 centimeter	=	0.394 inches
1 millimeter	=	1000 microns
1 micron	=	1000 nanometers
1 foot	=	30.48 centimeters
1 inch	=	25.4 millimeters
1 inch	=	1000 mils
1 mil	=	25.4 microns
1 micron	=	0.3937 mil
1 yard	=	36 inches

Conversion Factors

Degrees, Fahrenheit to Celsius

F	0	-1	-2	- 3	-4	- 5	- 6	- 7	- 8	9
-40	-40.0	-40.6	-41.1	-41.7	-42.2	-42.8	-43.3	-43.9	-44.4	-45.0
-30	-34.4	-35.0	-35.6	-36.1	-36.7	-37.2	-37.8	-38.3	-38.9	-39.4
-20	-28.9	-29.4	-30.0	-30.6	-31.1	-31.7	-32.2	-32.8	-33.3	-33.9
-10	-23.3	-23.9	-24.4	-25.0	-25.6	-26.1	-26.7	-27.2	-27.8	-28.3
0	-17.8	-18.3	-18.9	-19.4	-20.0	-20.6	-21.1	-21.7	-22.2	-22.8
+	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	-17.8	-17-.2	-16.7	-16.1	-15.6	-15.0	-14.4	-13.9	-13.3	-12.8
10	-12.2	-11.7	-11.1	-10.6	-10.0	-9.4	-8.9	-8.3	-7.8	-7.2
20	-6.7	-6.1	-5.6	-5.0	-4.4	-3.9	-3.3	-2.8	-2.2	-1.7
30	-1.1	-0.6	0.0	0.6	1.1	1.7	2.2	2.8	3.3	3.9
40	4.4	5.0	5.6	6.1	6.7	7.2	7.8	8.3	8.9	9.4
50	10.0	10.6	11.1	11.7	12.2	12.8	13.3	13.9	14.4	15.0
60	15.6	16.1	16.7	17.2	17.8	18.3	18.9	19.4	20.0	20.6
70	21.1	21.7	22.2	22.8	23.3	23.9	24.4	25.0	25.6	26.1
80	26.7	27.2	27.8	28.3	28.9	29.4	30.0	30.6	31.1	31.7
90	32.2	32.8	33.3	33.9	34.4	35.0	35.6	36.1	36.7	37.2
100	37.8	38.3	38.9	39.4	40.0	40.6	41.1	41.7	42.2	42.8
110	43.3	43.9	44.4	45.0	45.6	46.1	46.7	47.2	47.8	48.3
120	48.9	49.4	50.0	50.6	51.1	51.7	52.2	52.8	53.3	53.9
130	54.4	55.0	55.6	56.1	56.7	57.2	57.8	58.3	58.9	59.4
140	60.0	60.6	61.1	61.7	62.2	62.8	63.3	63.9	64.4	65.0
150	65.6	66.1	66.7	67.2	67.8	68.3	68.9	69.4	70.0	70.6
160	71.1	71.7	72.2	72.8	73.3	73.9	74.4	75.0	75.6	76.1
170	76.7	77.2	77.8	78.3	78.9	79.4	80.0	80.6	81.1	81.7

Temperature Conversion Nomograph



FAHRENHEIT, °F

$$°F = (°C \times \frac{9}{5}) + 32$$

CELSIUS, °C

$$°C = \frac{5}{9} (°F - 32)$$

KELVIN, °K

$$°K = °C + 273$$

Wire Gauge Data (AWG)

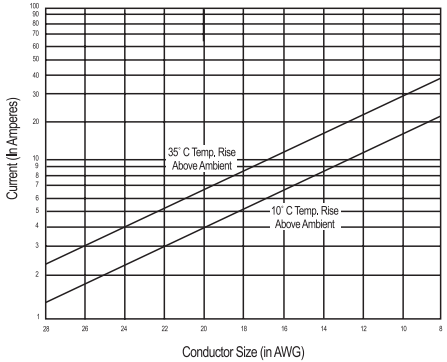
AWG	Diameter mils, d	Area, circular mils, d^2	Ohms per 1000 ft. at 20°C, or 68° F	Weight per 1000 ft. (lbs.)
0000	460.00	211,600	0.04901	640.5
000	409.64	167,805	0.06180	508.0
00	364.80	133.079	0.07793	402.8
0	324.86	105.534	0.09827	319.5
1	289.30	83,694	0.1239	253.3
2	257.63	66.373	0.1563	200.9
3	229.42	52,634	0.1970	159.3
4	204.31	41,743	0.2485	126.4
5	181.94	33,102	0.3133	100.2
6	162.02	26,250	0.3951	79.46
7	144.28	20,817	0.4982	63.02
8	129.49	16,768	0.6282	49.98
9	114.43	13,094	0.7921	39.63
10	101.89	10,382	0.9989	31.43
11	90.742	8,234.1	1.260	24.93
12	80.808	6,529.9	1.588	19.77
13	71.961	5,178.4	2.003	15.68
14	64.084	4,106.8	2.525	12.42
15	57.068	3,256.8	3.184	9.858
16	50.820	2,582.7	4.016	7.818
17	45.257	2,048.2	5.064	6.200
18	40.303	1,624.3	6.385	4.917
19	35.890	1,288.1	8.051	3.899
20	31.961	1,021.5	10.15	3.092
21	28.465	810.10	12.80	2.452
22	25.347	642.47	16.14	1.945
23	22.571	509.45	20.36	1.542
24	20.100	404.01	25.67	1.223
25	17.900	320.41	32.37	0.9699
26	15.940	254.08	40.81	0.7692
27	14.195	201.50	51.47	0.6100
28	12.641	159.79	64.90	0.4837
29	11.257	126.72	81.83	0.3836
30	10.025	100.50	103.2	0.3042
31	8.928	79.71	130.1	0.2413
32	7.950	63.20	164.1	0.1913
33	7.080	50.13	206.9	0.1517
34	6.305	39.75	260.9	0.1203
35	5.615	31.53	329.0	0.0954
36	5.000	25.00	414.8	0.0757
37	4.453	19.83	523.1	0.0600
38	3.965	15.72	059.6	0.0476
39	3.531	12.47	831.8	0.0377
40	3.145	9.89	1049	0.0299

Current Ratings for Electronic Cables

The maximum continuous current rating for an electronic cable is limited by conductor size, number of conductors contained within the cable, maximum temperature rating of the cable, and environmental conditions such as ambient temperature and air flow.

To use the current capacity chart, first determine conductor size, temperature rating, and number of conductors from the applicable product description for the cable of interest.

Next, find the current value on the chart for the proper temperature rating and conductor size. To calculate the maximum current rating/conductor, multiply the chart value by the appropriate conductor factor. The chart assumes cable is surrounded by still air at an ambient temperature of 25° C. Current values are in RMS Amperes and are valid for copper conductors only.

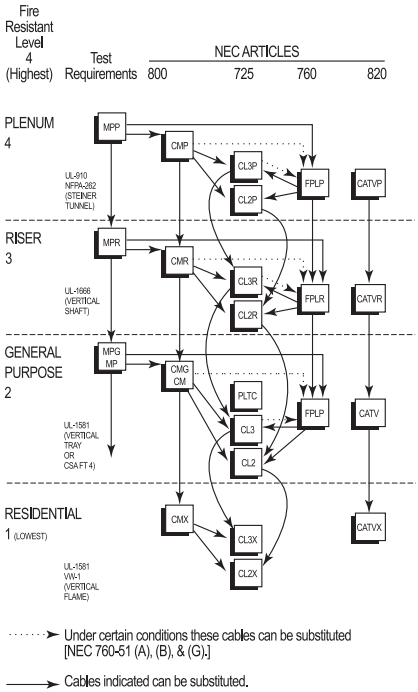


No. of Conductors** Factors	
1	1.6
2 - 3	1.0
4 - 5	.8
6 - 15	.7
16 - 30	.5

NOTE: Current ratings are intended as general guidelines for low power electronic communications and control applications. Current ratings for power applications generally are set by regulatory agencies such as UL, CSA, NEC, and others.

** Do not count shields unless used as a conductor.

Cable Substitution Chart (Per NEC*)



Type MP =
Multipurpose Cables

Type CM =
Communications Cables

Type CL2, CL3 =
Class 2 and Class 3 Remote Control, Signaling and Power Limited Cables

Type FPL =
Power-Limited Fire Alarm Cables

Type CATV =
Community Antenna Television and Radio Distribution Cables

Type OFN =
Non-conductive Optical Fiber Cables

Type OFC =
Conductive Optical Fiber Cables

Type PLTC =
Power-Limited Tray Cables

Type CMG =
A CM Which Passes CSA FT4

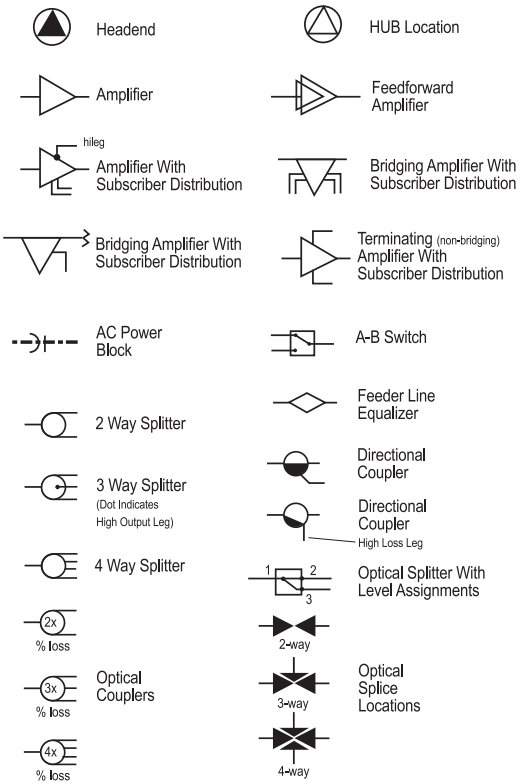
Type MPG=
A MP Which Passes CSA FT4

Type OFNG=
A OFN Which Passes CSA FT4

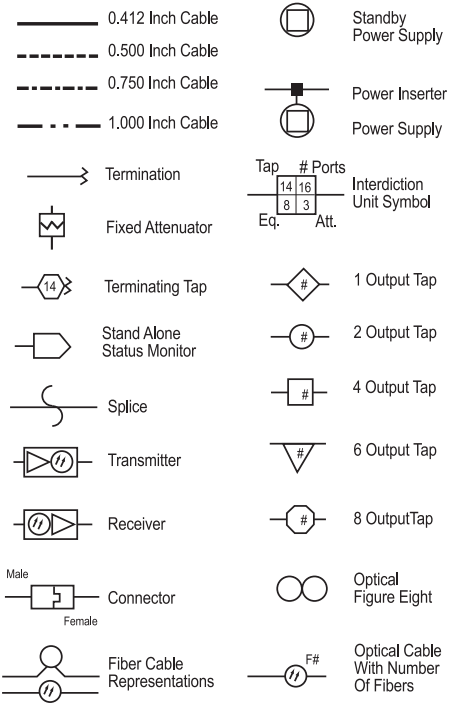
Type OFCG=
A OFC Which Passes CSA FT4

*National Electrical Code and NEC are registered trademarks of the National Fire Protection Association, Inc., Quincy, MA.

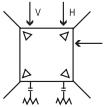
Common CATV Symbols



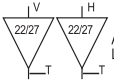
Common CATV Symbols



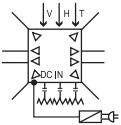
Digital “L-Band” Distribution Symbols



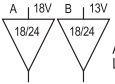
Multiswitch
SMS 3400



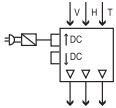
Amplifier
LDA 28-2



Multiswitch
SMS 3810

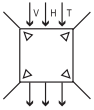


Amplifier
LDAP-24



Multiswitch
SMK 3340

Amplifier
LDA 36



Multiswitch
LA 3310

Amplifier
LA124-20
LA922-20

Multiswitch
LPI 3300

Booster Amp
LPA-10

Power Supply:

Multiswitch
LPI 188Ps

Power Inserter
LPI 2200

Amplifiers
PS120-1218; PS120-12;
LPI 122PS; LPI 183PS

Digital “L-Band” Distribution Symbols

1 Port
Dir. Coupler
DCL-108

1 Port
Dir. Coupler
DCL-112

1 Port
Dir. Coupler
DCL-116

1 Port
Dir. Coupler
DCL-120

1 Port
Dir. Coupler
DCL-124

2 Port
Dir. Coupler
DCL-212

2 Port
Dir. Coupler
DCL-216

2 Port
Dir. Coupler
DCL-220

2 Port
Dir. Coupler
DCL-224

4 Port
Dir. Coupler
DCL-412

4 Port
Dir. Coupler
DCL-416

4 Port
Dir. Coupler
DCL-420

4 Port
Dir. Coupler
DCL-424

Trunk Grade
Splitter
LPD-2

Trunk Grade
Splitter
LPD-2p

Trunk Grade
Splitter
LPD-3p

Trunk Grade
Splitter
LPD-4

Trunk Grade
Splitter
LPD-4p

Trunk Grade
Splitter
LPD-6

Trunk Grade
Splitter
LPD-6p

Trunk Grade
Splitter
LPD-8

Trunk Grade
Splitter
LPD-8p

Diplexer
LUV 2150

Terminator
LTF 2150

Passive & Coaxial Cable Characteristics

Cable and Equalizer Formulas

1. Cable Loss Ratio

The ratio of cable attenuation at two frequencies is approximately equal to the square root of the ratio of the two frequencies.

$$\text{Cable Loss Ratio} = \sqrt{\frac{f_1}{f_2}}$$

Example: To calculate the approximate cable loss at 55 MHz when the loss at 450 MHz is 20 dB,

$$\text{Attenuation (at 55 MHz)} = \sqrt{\frac{55}{450}} \times 20 = 6.99 \text{ dB}$$

2. Tilt to Cable Loss

To convert tilt (differential in signal level between end frequencies of the cable bandpass) to cable loss at the highest frequency:

$$\text{dB of Cable} = \frac{\text{Tilt (dB)}}{1-\sqrt{\frac{f_1}{f_2}}}$$

Example: To calculate the cable loss at the highest frequency when the measured tilt is 12 dB between 55 and 450 MHz

$$\text{dB of Cable} = \frac{12}{1-\sqrt{\frac{55}{450}}} = 18.45 \text{ dB}$$

Cable and Equalizer Formulas

3. Equalizer Loss at any Frequency

To calculate the equalizer loss at any frequency, the following formula may be used:

$$\text{Loss at } f_1 = \text{Eq. Value} - \left(\left(\text{Eq. value} \times \sqrt{\frac{f_1}{f_2}}\right) - 1\right)$$

Example: To calculate the loss of an equalizer for 20 dB of cable at 450 MHz at a frequency f1 of 55 MHz,

$$\text{Loss at 55 MHz} = 20 - \left(\left(20 \times \sqrt{\frac{55}{450}}\right) - 1\right) = 14.01 \text{ dB}$$

Cable Loss Conversion Chart

Use this chart to find a cable span's attenuation at a new frequency if you already know its attenuation at one frequency.

If you know the cable loss at f_1 and want to find the corresponding loss at a higher frequency f_2 multiply the loss at f_1 by the conversion factor. The result is the cable loss at f_2.

If you know the cable loss at f_2 and want to find the corresponding loss at a lower frequency f_1 divide the loss at f_2 by the conversion factor. The result is the cable loss at f_1.

f_1 (MHz)	f_2 (MHz)	$\sqrt{\frac{f_2}{f_1}}$	f_1 (MHz)	f_2 (MHz)	$\sqrt{\frac{f_2}{f_1}}$
220	270	1.108	400	440	1.049
220	300	1.168	400	500	1.118
220	330	1.225	400	550	1.173
220	400	1.348	400	600	1.225
220	440	1.414	400	750	1.369
220	500	1.508	400	860	1.466
220	550	1.581	400	1000	1.581
220	600	1.651			
270	300	1.054	440	500	1.066
270	330	1.106	440	550	1.118
270	400	1.217	440	600	1.168
270	440	1.277	440	750	1.306
270	500	1.361	440	860	1.398
270	550	1.427	440	1000	1.508
270	600	1.491			
300	330	1.049	500	550	1.049
300	400	1.155	500	600	1.095
300	440	1.211	500	750	1.225
300	500	1.291	500	860	1.311
300	550	1.354	500	1000	1.414
300	600	1.414			
330	400	1.101	550	600	1.044
330	440	1.155	550	750	1.168
330	500	1.231	550	860	1.250
330	550	1.291	550	1000	1.348
330	600	1.348	1000	1250	1.118
330	750	1.508	1000	1500	1.225
330	860	1.614	1000	1750	1.323
330	1000	1.741	1000	2000	1.414
			1000	2150	1.466

Example: If a cable span attenuates a 220 MHz signal by 10 dB, by how much will it attenuate a 300 MHz signal?

Loss at 300 MHz = Loss at 220 MHz x conversion factor = 10 dB x 1.168 = 11.68 dB

Cable Loss and Temperature

This equation calculates the percentage of change in cable attenuation (loss) caused by a temperature change:

% change in cable loss = 1.1% per 10° F

This equation calculates the change in cable loss in a span of cable, expressed in dB.

change in cable loss (in dB) = standard loss x % change in cable loss

Example: If the standard loss is 22 dB* when the temperature is 70°F and the temperature drops to -40°F, what is the change in attenuation for that cable span?

1. Determine the number of degrees of temperature change.
   $T = T_2 - T_1 = (-40°F) - 70°F = (-110° F)$

2. Find the percent change in cable loss.
   % change = 1% per 10°F x (-110°F)
   = (1%/10°F) x (-110°F)
   = - 11%

3. Find the dB change in the span's loss.
   Change in cable loss (in dB) = -11% x 22 dB
   = -2.42 dB

So, if the span's loss was 22 dB at 70°F it becomes 22 dB + (-2.42 dB) = 19.58 dB at -40°F.

Changes in cable loss accumulate over multiple cable spans and can cause performance degradation if not controlled by AGC/ASC units.

Typical Cable Attenuation Chart in dB/100 Feet @ 68°F (20°C)

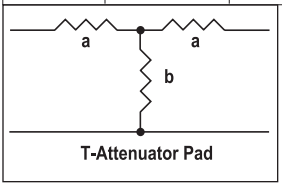
Freq	Drop Cable				Semi Flex Cable									
(MHz)	RG59	RG6	RG7	RG11	412	500	625	750	875	1000	565	700	840	1160
5	0.77	0.57	0.56	0.36	0.20	0.16	0.13	0.11	0.09	0.08	0.14	0.11	0.09	0.07
55	1.88	1.50	1.22	0.95	0.68	0.55	0.45	0.37	0.32	0.29	0.47	0.37	0.32	0.24
211	3.59	2.87	2.29	1.81	1.35	1.08	0.89	0.73	0.64	0.58	0.93	0.74	0.64	0.48
250	3.89	3.12	2.49	1.98	1.49	1.19	0.98	0.81	0.70	0.64	1.03	0.82	0.70	0.53
270	4.05	3.24	2.59	2.06	1.55	1.24	1.02	0.84	0.73	0.67	1.07	0.85	0.73	0.56
300	4.27	3.43	2.74	2.17	1.64	1.31	1.08	0.89	0.78	0.72	1.13	0.90	0.77	0.59
330	4.50	3.61	2.89	2.29	1.73	1.38	1.14	0.94	0.82	0.76	1.19	0.95	0.82	0.63
350	4.64	3.72	2.98	2.36	1.78	1.43	1.18	0.97	0.84	0.78	1.23	0.98	0.84	0.65
400	4.88	4.00	3.20	2.53	1.91	1.53	1.27	1.05	0.91	0.84	1.32	1.05	0.91	0.70
450	5.30	4.28	3.41	2.69	2.03	1.63	1.35	1.12	0.97	0.90	1.40	1.12	0.97	0.75
500	5.50	4.51	3.61	2.85	2.15	1.73	1.43	1.18	1.03	0.96	1.49	1.19	1.03	0.80
550	5.90	4.76	3.80	3.01	2.26	1.82	1.51	1.25	1.09	1.01	1.56	1.25	1.09	0.84
600	6.18	4.98	3.99	3.16	2.37	1.91	1.58	1.31	1.14	1.06	1.64	1.31	1.14	0.89
750	6.96	5.62	4.50	3.58	2.68	2.16	1.79	1.48	1.29	1.21	1.85	1.49	1.30	1.01
870	7.54	6.09	4.87	3.90	2.90	2.35	1.95	1.61	1.41	1.33	2.01	1.62	1.41	1.11
950	7.90	6.39	5.11	4.10	3.03	2.49	2.04	1.72	1.50	1.35	2.15	1.75	1.51	1.15
1000	8.09	6.54	5.25	4.23	3.13	2.53	2.11	1.74	1.53	1.44	2.17	1.75	1.53	1.20
1200	8.91	7.18	5.77	4.71	3.44	2.83	2.32	1.96	1.72	1.55	2.45	2.00	1.72	1.33
1450	9.82	7.89	6.34	5.29	3.81	3.12	2.61	2.16	1.90	1.81	2.66	2.13	1.90	1.52
1750	10.92	8.74	6.93	5.95	4.23	3.47	2.92	2.41	2.13	2.03	2.96	2.36	2.13	1.71
1850	11.23	8.99	7.13	6.12	4.36	3.60	2.97	2.52	2.22	2.07	3.13	2.57	2.23	1.74
2000	11.67	9.34	7.41	6.36	4.55	3.76	3.12	2.64	2.32	2.11	3.27	2.69	2.33	1.82
2150	12.10	9.69	7.68	6.60	4.74	3.92	3.24	2.75	2.43	2.21	3.41	2.81	2.44	1.91
Loop Resist.	59.9	39.6	26.8	19.5	2.5	1.7	1.1	0.8	0.4	1.3	0.9	0.9	0.6	0.3

Note: Loop resistance shown in ohms/1000 ft.

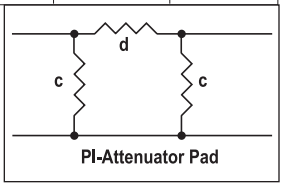
Miscellaneous Data & Constants

75 Ohm Attenuator Table & Equation

Loss (dB)	T-Attenuator Resistor (Ohm)		Pi-Attenuator Resistor (Ohm)	
	a	b	c	d
0.5	2.16	1302.16	2606.49	4.32
1.0	4.31	650.00	1304.32	8.65
1.5	6.46	432.14	870.75	13.02
2.0	8.60	322.86	654.32	17.42
2.5	10.72	257.01	524.75	21.89
3.0	12.82	212.89	438.60	26.42
4.0	16.97	157.24	331.46	35.77
5.0	21.01	123.36	267.73	45.60
6.0	24.92	100.40	225.71	56.03
7.0	28.69	83.70	196.09	67.20
8.0	32.29	70.96	174.21	79.27
9.0	35.72	60.89	157.49	92.38
10.0	38.96	52.70	144.37	106.73
11.0	42.02	45.92	133.87	122.49
12.0	44.89	40.22	125.32	139.87
13.0	47.56	35.35	118.27	159.11
14.0	50.05	31.17	112.39	180.46
15.0	52.35	27.55	107.44	204.21
16.0	54.48	24.39	103.25	230.67
17.0	56.43	21.62	99.67	260.18
18.0	58.23	19.19	96.60	293.15
19.0	59.87	17.04	93.96	330.01
20.0	61.36	15.15	91.67	371.25



T-Attenuator Pad



PI-Attenuator Pad

75 Ohm Attenuator Table & Equations

The equations necessary to calculate the resistance values in ohms for T and Pi pad Attenuators are as follows:

$$a = z\left[\frac{10^{n/20}-1}{10^{n/20}+1}\right] \qquad c = z\left[\frac{10^{n/20}+1}{10^{n/20}-1}\right]$$

$$b = 2z\left[\frac{10^{n/20}}{10^{2n/20}-1}\right] \qquad d = \frac{z}{2}\left[\frac{10^{2n/20}-1}{10^{n/20}}\right]$$

where:
n = loss in dB
z = impedance value in Ohm

To obtain resistance values at various impedances, simply multiply the resistances by the impedance value.

Example: Given n = 2.0, calculate the resistance values for a 75 Ohm T-Attenuator:

$$a = 75\left[\frac{10^{2/20}-1}{10^{2/20}+1}\right] = 75\left[\frac{1.259-1}{1.259+1}\right]$$

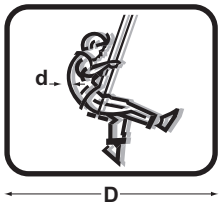
$$= 75\ (0.1146) = 8.60\ \Omega$$

$$b = 2(75)\left[\frac{10^{2/20}}{10^{2x2/20}-1}\right] = 150\left[\frac{1.259}{1.585-1}\right]$$

$$= 150(2.152) = 322.86\ \Omega$$

Ghosts

Ghosts are duplicates of the reproduced picture located to the right or left of the picture. Ghosts displaced to the left are generally due to ingress, for example, direct pick up. Assuming ghosts are not present in the signals at the headend, ghosts displaced to the right are generally indicative of impedance mismatches in the system, for example, devices with poor return loss.



The following will help to find the cause of a ghost that is displaced to the right.

$$X = \left(\frac{d}{D}\right) \times (V_P) \times 25845 \text{ ft.}$$

25845 = constant derived from speed of light x scan time for horizontal line

X = distance in feet between the source of reflection and re-reflection

d = displacement of ghost on TV set in inches

D = horizontal width of TV set in inches

Vp = Velocity of Propagation referenced to free air

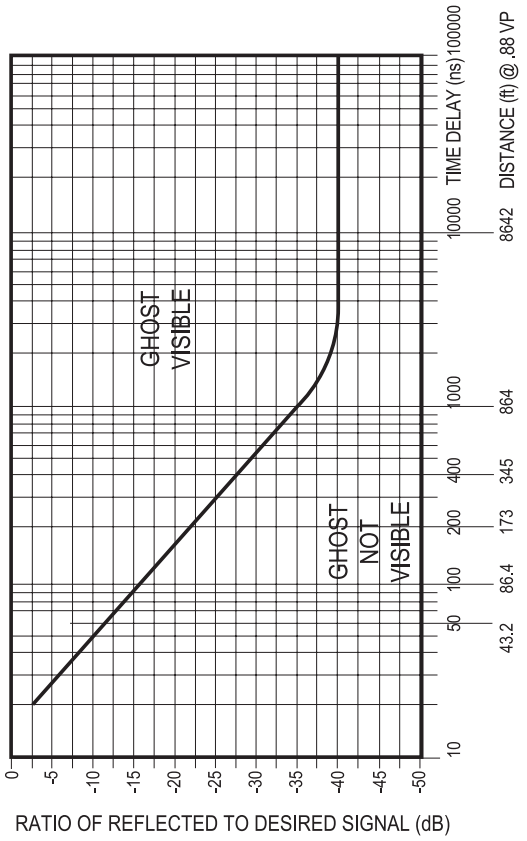
Example:

TV screen, D = 24 inches wide
Ghost image, d = 0.16 inches wide
Velocity of propagation for cable, Vp = 0.88

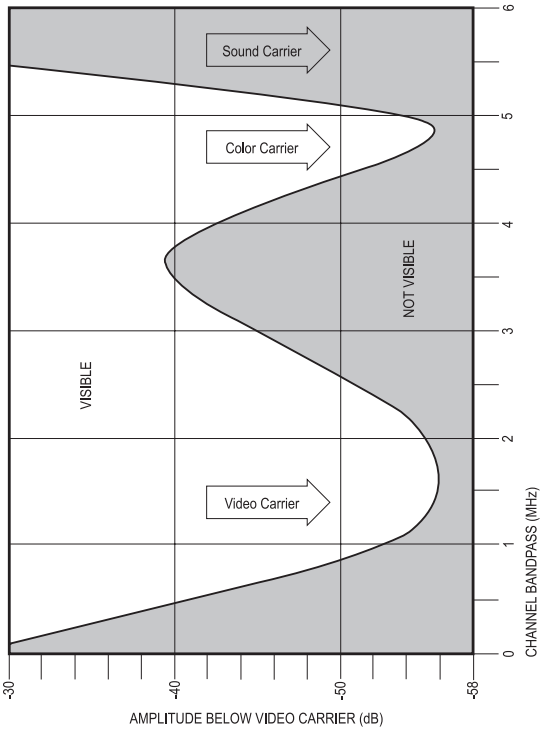
$$\frac{\text{X = (25845 ft) x (0.16 in) x (0.88)}}{\text{24 in.}} \text{ = 152 ft between devices}$$

Once distance X is calculated, check the system maps for both (1) **the circumstance** where there are devices that are approximately distance X apart and (2) that **the circumstance** is between to the signal source and the location where the ghost is being viewed.

Echo Rating Graph

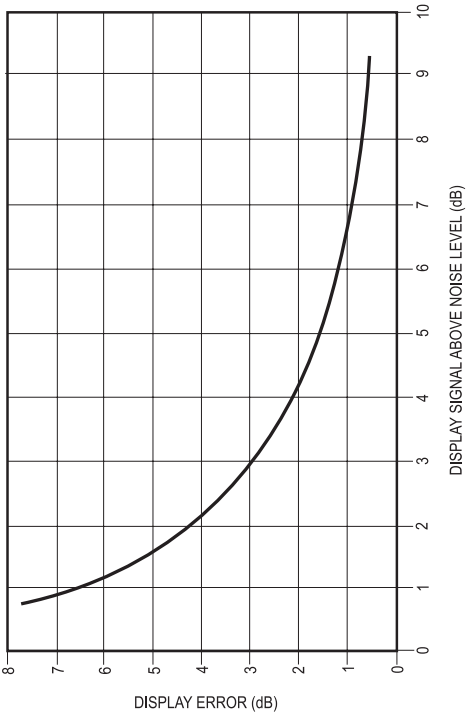


Signal to Interference Limits
Non-Coherent Carriers



Error Corrections Chart

Use this table to find the error correction when measuring levels within 10 dB of the noise floor. For example, measuring a level 7 dB above the noise floor would give a display error of 1 dB.



Heterodyne Modulator - Analog

Heterodyne Processor - Analog

Broadband RF Network Powering

When determining the power supply location in a cable system, it is important to know OHM's Law, cable loop resistance, amplifier current drain and the minimum operating voltage required for amplifier operation.

The cable resistance is included in the manufacturers specification sheet. Resistance is usually stated as center conductor, shield, and loop. Loop resistance is the sum of the center conductor and shield resistance.

The amplifier current drain and voltage requirements are also part of the manufacturers specifications.

The ideal location of the power supply is such that the current supplied flows equally both, away from, and towards the headend. The total current supplied should be between 80-90% of the power supply's rated output. Current passing through the amplifiers is usually limited to about 6 Amps. Since power supplies are available with various current handling abilities, one with slightly higher capability than required should be selected.

Determining power supply placement, refer to the figure on the next page.

1. First determine the loop resistance for each span of cable. Example: Loop resistance = 1.7 Ohms/1000 ft. x 800' = 1.36 Ohms.
2. Locate the last amplifier, determine the voltage drop across the span of cable.
3. Using the current draw of the amplifier, determine the voltage drop across the span of cable. Example: 0.375A x 1.36 Ohms = 0.51 volts.
4. Since the minimum operating voltage for the amplifier is 43 volts, the voltage level at the beginning of the 800' span would be 43.5 volts (43.0 + 0.51).
5. At this point, the total current flow in the coax will increase due to the addition of another amplifier. Current flow in this span of cable will be 0.75A (0.375 + 0.375).

Broadband RF Network Powering

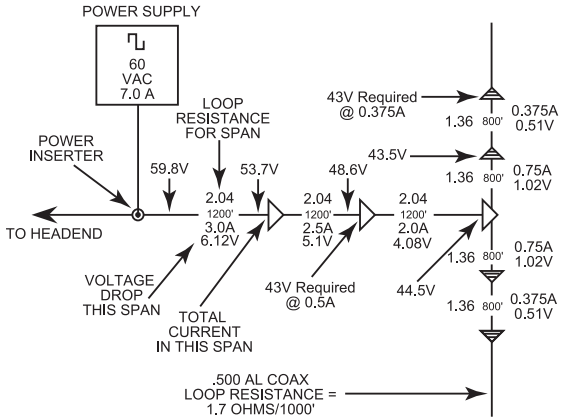
6. Determine the voltage across the next span of cable.

   0.75 x 1.36 Ohms = 1.02 Volts

   Therefore the voltage at the output of the bridger amp is 44.5 volts. The total current at the input to the bridger amp is 2.0 amps. This is the sum of both output legs of the bridger (1.5A) and the current draw of the bridger amp itself.

7. Continue working towards the headend until the current draw is 40-50% of the power supplies rated capability or the voltage level nears 60 volts.

8. At this time, a guesstimate of where to place a power block in the section between the power supply and headend must be made. Add the current draw for the line extender(s) off each trunk station to the trunk station current requirements. A few trial calculations will show how many amplifiers can be powered going in this direction.



FCC Rules

Cumulative Leakage Index

Cumulative Leakage Index (CLI), also referred to as a "figure of merit" measurement, is a method for assessing the leakage integrity of a cable plant. The cable operator demonstrates compliance with a cumulative signal leakage index by showing either that:

$$10 \log I_{3000} \leq -7 \qquad 10 \log I_{\infty} \leq 64$$

using either:

$$I_{3000} = \frac{1}{} \sum_{i=1}^{n} \frac{E_i^2}{R_i^2} \qquad I_{\infty} = \frac{1}{} \sum_{i=1}^{n} E_i^2$$

where:

$$R_i^2 = r_i^2 + (3000)^2$$

and where:

r = Distance in meters (m) between the leakage source and the center of the cable system.

ø = Fraction of the system cable length actually examined for leakage sources. The fraction is equal to the strand miles tested divided by total strand miles.

R = Slant height distance (m) from leakage source i to a point 3,000 meters above the center of the cable system.

E = Electric field strength in microvolts per meter (μV/m) measured 3 meters from leak i.

n = Number of leaks found with a field strength ≥ 50 μV/m.

FCC Rules

Cumulative Leakage Index - continued

The following formula may be substituted to determine the CLI figure of merit. Compliance is attained if the formula yields a figure of merit less than or equal to 64.

$$10 \log \left[\left(\frac{M_p}{M_d} \right) \left(\sum_{i=1}^{n} n_i L_i^2 \right) \right] \leq 64$$

where:

Mp = Total Plant Miles (miles)
Md = Total Plant Miles Driven (miles)
n = Number of leaks with the same level
L = Level of the leak in microvolts per meter (μV/m)
k = Number of different levels

Example: Given the following information about a cable system, determine the CLI.

Mp = Total plant miles = 1500 miles

Md = Plant miles driven = 1350 miles

Number of leaks and level of each in μV/m =
n1 = 300 leaks @ L1 = 50 μV/m
n2 = 30 leaks @ L2 = 100 μV/m
n3 = 3 leaks @ L3 = 450 μV/m

Sum of: niLi2 + n2L22 + n3L32 =
(300 x 50 x 50) + (30 x 100 x 100) + (3 x 450 x 450) =
750000 + 300000 + 607500 =
1657500

CLI = 10 log (1.11 x 1657500)
= 10 log (1839825)
= *62.65 ≤ 64*

FCC Rules

Maximum Leakage Levels

The following table gives the maximum leakage levels at the given channels and voltage level.

CH#	Visual Carrier	20 µV/M (dBmV)	50 µV/m (dBmV)	CH#	Visual Carrier	20 µV/M (dBmV)	50 µV/m (dBmV)
T-7	7.0000	-17.33	-9.37	25	229.2625	-47.63	-39.67
T-8	13.0000	-22.70	-14.74	26	235.2625	-47.85	-39.90
T-9	19.0000	-26.00	-18.04	27	241.2625	-48.07	-40.11
T-10	25.0000	-28.38	-20.42	28	247.2625	-48.29	-40.33
T-11	31.0000	-30.25	-22.29	29	253.2625	-48.50	-40.54
T-12	37.0000	-31.79	-23.83	30	259.2625	-48.70	-40.74
T-13	43.0000	-33.09	-25.13	31	265.2625	-48.90	-40.94
2	55.2500	-35.27	-27.31	32	271.2625	-49.09	-41.13
3	61.2500	-36.17	-28.21	33	277.2625	-49.28	-41.32
4	67.2500	-36.98	-29.02	34	283.2625	-49.47	-41.51
5	77.2500	-38.18	-30.22	35	289.2625	-49.65	-41.69
6	83.2500	-38.83	-30.87	36	295.2625	-49.83	-41.87
14	121.2625	-42.10	-34.14	37	301.2625	-50.00	-42.04
15	127.2625	-42.52	-34.56	38	307.2625	-50.17	-42.22
16	133.2625	-42.92	-34.96	39	313.2625	-50.34	-42.38
17	139.2500	-43.30	-35.34	40	319.2625	-50.51	-42.55
18	145.2500	-43.67	-35.71	41	325.2625	-50.67	-42.71
19	151.2500	-44.02	-36.06	42	331.2625	-50.83	-42.87
20	157.2500	-44.36	-36.40	43	337.2625	-50.98	-43.02
21	163.2500	-44.68	-36.72	44	343.2625	-51.14	-43.18
22	169.2500	-44.99	-37.04	45	349.2625	-51.29	-43.33
7	175.2500	-45.30	-37.34	46	355.2625	-51.43	-43.48
8	181.2500	-45.59	-37.63	47	361.2625	-51.58	-43.62
9	187.2500	-45.87	-37.91	48	367.2625	-51.72	-43.76
10	193.2500	-46.15	-38.19	49	373.2625	-51.86	-43.91
11	199.2500	-46.41	-38.45	50	379.2625	-52.00	-44.04
12	205.2500	-46.67	-38.71	51	385.2625	-52.14	-44.18
13	211.2500	-46.92	-38.96	52	391.2625	-52.27	-44.31
23	217.2500	-47.16	-39.20	53	397.2625	-52.41	-44.45
24	223.2500	-47.40	-39.44	54	403.2500	-52.54	-44.58

FCC Rules

Maximum Leakage Levels - continued

CH.	Visual Carrier	20 µV/M (dBmV)	50 µV/m (dBmV)	CH.	Visual Carrier	20 µV/M (dBmV)	50 µV/m (dBmV)
55	409.2500	-52.66	-44.70	88	607.2500	-56.09	-48.13
56	415.2500	-52.79	-44.83	89	613.2500	-56.18	-48.22
57	421.2500	-52.91	-44.96	90	619.2500	-56.26	-48.30
58	427.2500	-53.04	-45.08	91	625.2500	-56.34	-48.39
59	433.2500	-53.16	-45.20	92	631.2500	-56.43	-48.47
60	439.2500	-53.28	-45.32	93	637.2500	-56.51	-48.55
61	445.2500	-53.40	-45.44	94	643.2500	-56.59	-48.63
62	451.2500	-53.51	-45.55	100	649.2500	-56.67	-48.71
63	457.2500	-53.63	-45.67	101	655.2500	-56.75	-48.79
64	463.2500	-53.74	-45.78	102	661.2500	-56.83	-48.87
65	469.2500	-53.85	-45.89	103	667.2500	-56.91	-48.95
66	475.2500	-53.96	-46.00	104	673.2500	-56.99	-49.03
67	481.2500	-54.07	-46.11	105	679.2500	-57.06	-49.11
68	487.2500	-54.18	-46.22	106	685.2500	-57.14	-49.18
69	493.2500	-54.29	-46.33	107	691.2500	-57.22	-49.26
70	499.2500	-54.39	-46.43	108	697.2500	-57.29	-49.33
71	505.2500	-54.49	-46.54	109	703.2500	-57.37	-49.41
72	511.2500	-54.60	-46.64	110	709.2500	-57.44	-49.48
73	517.2500	-54.70	-46.74	111	715.2500	-57.51	-49.55
74	523.2500	-54.80	-46.84	112	721.2500	-57.59	-49.63
75	529.2500	-54.90	-46.94	113	727.2500	-57.66	-49.70
76	535.2500	-54.99	-47.04	114	733.2500	-57.73	-49.77
77	541.2500	-55.09	-47.13	115	739.2500	-57.80	-49.84
78	547.2500	-55.19	-47.23	116	745.2500	-57.87	-49.91
79	553.2500	-55.28	-47.32	117	751.2500	-57.94	-49.98
80	559.2500	-55.38	-47.42	118	757.2500	-58.01	-50.05
81	565.2500	-55.47	-47.51	119	763.2500	-58.08	-50.12
82	571.2500	-55.56	-47.60	120	769.2500	-58.15	-50.19
83	577.2500	-55.65	-47.69	121	775.2500	-58.21	-50.25
84	583.2500	-55.74	-47.78	122	781.2500	-58.28	-50.32
85	589.2500	-55.83	-47.87	123	787.2500	-58.35	-50.39
86	595.2500	-55.92	-47.96	124	793.2500	-58.41	-50.45
87	601.2500	-56.00	-48.05	125	799.2500	-58.48	-50.52

FCC Rules

Maximum Leakage Levels - continued

CH.	Visual Carrier	20 µV/m (dBmV)	50 µV/m (dBmV)	CH.	Visual Carrier	20 µV/M (dBmV)	50 µV/m (dBmV)
126	805.2500	-58.54	-50.58	143	907.2500	-59.58	-51.62
127	811.2500	-58.61	-50.65	144	913.2500	-59.64	-51.68
128	817.2500	-58.67	-50.71	145	919.2500	-51.73	-51.73
129	823.2500	-58.73	-50.78	146	925.2500	-59.75	-51.79
130	829.2500	-58.80	-50.84	147	931.2500	-59.81	-51.85
131	835.2500	-58.86	-50.90	148	937.2500	-59.86	-51.90
132	841.2500	-58.92	-50.96	149	943.2500	-59.92	-51.96
133	847.2500	-58.98	-51.03	150	949.2500	-59.97	-52.01
134	853.2500	-59.05	-51.09	151	955.2500	-60.03	-52.07
135	859.2500	-59.11	-51.15	152	961.2500	-60.08	-52.12
136	865.2500	-59.17	-51.21	153	967.2500	-60.13	-52.18
137	871.2500	-59.23	-51.27	154	973.2500	-60.19	-52.23
138	877.2500	-59.29	-51.33	155	979.2500	-60.24	-52.28
139	883.2500	-59.35	-51.39	156	985.2500	-60.29	-52.34
140	889.2500	-59.40	-51.45	157	991.2500	-60.35	-52.39
141	895.2500	-59.46	-51.50	158	997.2500	-60.40	-52.44
142	901.2500	-59.52	-51.56				

Determine the maximum leakage levels by using the following equation:

$$L = 20\log\left[\frac{E}{21_{\acute{E}}}\right]$$

where:

L = Maximum leakage level (dBmV)
E = Voltage
f = Visual Carrier Frequency (MHz)

Step 1
Convert dBmV to µV.
Use tables in Section 6 to convert dBmV to mV. Multiply mV by 1000 to set µV.

Step 2
Convert µV to µV/m.
Multiply µV times frequency (in MHz) times .021

Highlights of FCC Rules & Regulations Part 76

This section is a summary of FCC specifications that CATV systems are required to meet. This section was created so technicians and engineers could have a ready reference at their fingertips.

All specifications in this handbook were taken from Title 47 Telecommunications, part 76.605 from the FCC. It spells out the rule, standard, number of channels to be tested, frequency of testing, and equipment needed to perform each test.

The intention of this section is to summarize FCC specifications it is not intended to replace them. Consult the current editions of all specifications and regulations for complete and detailed requirements.

Aeronautical Operational Requirements

Frequency Offsets

All carrier signals or signal components carried at an average power level equal to or greater than 10-4 watts in a 25 kHz bandwidth in any 160 microseconds period must operate at frequencies offset from certain frequencies which may be used by aeronautical radio services operated by FCC licensees or by the United States Government or its Agencies. The following table summarizes the frequency offset requirements.

Frequency Offsets		
Frequency Band(Standard and IRC)	**Offset**	**Tolerance**
118-137, 225-325.6 and 335.4-400 MHz	12.5 kHz	±5 kHz
108-118 and 328.6-335.4 MHz	25.0 kHz	±5 kHz

For Harmonically Related Carrier (HRC) systems, the fundamental frequency from which the visual carrier frequencies are derived should be a multiple of 6.0003 MHz ±1 Hz

http://www.fcc.gov/Bureaus/Cable/WWW/aeronaut.html

Highlights of FCC Rules & Regulations Part 76

Aeronautical Frequency Notifications

Cable operators planning to use the frequencies in the communications and navigational frequency bands must notify the FCC prior to the activation of these frequencies. The aeronautical operational requirements in the aeronautical bands are contained in 47 CFR Sections 76.610-76.616. Each notification shall include an FCC Form 159.

- ❏ Legal name and local address of the cable television operator;
- ❏ The names and FCC identifiers (e.g. CA0001) of the system communities affected;
- ❏ The names and telephone numbers of local system officials who are responsible for compliance with 76.610, 76.611, and 76.612 through 76.616 of the rules;
- ❏ Carrier and subcarrier frequencies and tolerance, type of modulation and the maximum average power levels of all carriers and subcarriers occurring at any location in the cable distribution system;
- ❏ The geographical coordinates of a point near the center of the cable system, together with the distance (in kilometers) from the designated point to the most remote point of the cable plant, existing or planned, which defines a circle enclosing the entire cable plant;
- ❏ A description of the routine monitoring procedure to be used;
- ❏ The cumulative leakage index derived under 76.611 (a)(1) or the results of airspace measurements derived under 76.611 (a)(2), including a description of the method by which compliance with the basic signal leakage criteria is achieved and the method of calibrating the measurement equipment. Use FCC Form 320 to submit the results.

Visual Carrier Center Frequency
Tolerance: aeronautical channels ± 5 KHz indicated by asterisk. For all other channels no specific tolerance indicated by FCC. Good engineering practice ± 10 KHz for non broadcast. Local VHF broadcasts carried "on channel" should be zero frequency tolerance. See Option 14 in Section 1.

Rule	76.605 (a)(2) Aural Carrier Center Frequency
Standard	4.5 MHz 5 kHz at subscriber terminal & out put of modulating or processing equipment
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	Spectrum analyzer, frequency counter, or automated testing system

Rule	76.605 (a)(3) Minimum Visual Carrier Level
Standard	0 dBmV at subscriber terminal and 3.0 dBmV at end of 100 ft. drop cable connected to tap
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	Two times per year
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(4) Visual Carrier Level 24 Hour Variation
Standard	Not to vary more than 8 dB within any six month interval (measured before the converter)
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	In July/August and January/February, 1 test each channel every 6 hours for each 24 hour test
Type Of Equipment	SLM, system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(4)(i) Maximum Signal Level of Adjacent Channel
Standard	Within 3 dB of any visual carrier within 6 MHz
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	In July/August and January/February, 1 test each channel every 6 hours for each 24 hour test
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Highlights of FCC Rules & Regulations Part 76

Rule	76.605 (a) (4) (ii) Minimum/Maximum Bandwidth
Standard	Within 10 dB of the visual signal on any other channel on a cable system of up to 300 MHz. A 1 dB increase in level separation for each additional 100 MHz of bandwidth 11 dB for a 400 MHz System 12 dB for a 500 MHz System 13 dB for a 600 MHz System
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	In July/August and January/February, 1 test each channel every 6 hours for each 24 hour test
Type Of Equipment	SLM, system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a) (4) (iii) Maximum Visual
Standard	A maximum level that will not overload the subscribers terminal or receiver
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	Two times per year
Type Of Equipment	SLM, system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(5) Aural Carrier Level
Standard	10 dB to 17 dB below the associated visual signal level. Baseband converter: 6.5 dB to 17 dB below the associated visual-signal level
Number Of Channels	All NTSC or similar video channels
Frequency Of Testing	Two times per year
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(6) Amplitude Characteristic of a Single CATV Channel
Standard	± 2 dB from -0.75 MHz to 5.0 MHz from the channels bottom boundary at tap and before converter (prior to Dec. 30, 1999) above lower boundary frequency of CATV channel (referenced to average of the highest and lowest amplitudes)
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	Sweep transmitter/receiver, spectrum analyzer, or automated test system

Highlights of FCC Rules & Regulations Part 76

Rule	**76.605 (a)(7)(ii) Carrier to Noise (C/N) 76.605 (a)(7)(iii) Carrier to Noise (C/N)**
Standard	Carrier to noise shall not be less than: 1) 40 dB (June 30,1993-June 30, 1995) 2) 43 dB (As of July 1,1995)
Number Of Channels	4 channels minimum, + 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Rule	**76.605 (a)(8)(i) Visual Signal-to-Coherent Beats**
Standard	Not less than 51 dB for non-coherent (standard) CATV systems Or not less than 47 dB for coherent (HRC/IRC) CATV systems
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(9)(i)(ii) Terminal Isolation
Standard	Not less than 18 dB (manufacturer's specification) and sufficient to prevent subscriber-caused terminal reflections
Number Of Channels	4 channel minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	Manufacturer's specifications

Rule	76.605 (a)(10) Hum
Standard	Not to exceed 3% of visual signal level
Number Of Channels	Only on a single channel with a single unmodulated carrier
Frequency Of Testing	Two times per year Testing
Type Of Equipment	SLM system analyzer, spectrum analyzer, or automated test system

Rule	76.605 (a)(11)(i) Chrominance Luminance Delay
Standard	± 170 ns
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	once every 3 years Testing
Type Of Equipment	Vectorscope, waveform monitor, or automated test system

Rule	76.605 (a)(11)(ii) Differential Gain
Standard	Not to exceed ± 20%
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	once every 3 years Testing
Type Of Equipment	Vectorscope, waveform monitor, or automated test system

Highlights of FCC Rules & Regulations Part 76

Rule	**76.605 (a)(11)(iii) Differential Phase**
Standard	Not to exceed ± 10 degrees
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz 8 Channels/54-500 MHz
Frequency Of Testing	once every 3 years
Type Of Equipment	Vectorscope, waveform monitor, or automated test system

Rule	**76.605 (a)(12) RF Signal Leakage**
Standard	< 54 MHz = 15 µV/M @ 30 m 54-216 MHz = 20 µV/M @ 3 m >216 MHz = 15µV/M @ 30 m
Number Of Channels	4 channels minimum, plus 1 channel for every 100 MHz or fractional increase: 5 Channels/54-216 MHz 6 Channels/54-300 MHz 7 Channels/54-400 MHz
Frequency Of Testing	Two times per year
Type Of Equipment	SLM, system analyzer, or spectrum analyzer and dipole, leakage field strength meter

Broadband Communication Design & Performance Standards

Parameter	IEEE 802.7	MAP*	FCC
C/L Delay			± 170 ns
Differential Gain			± 20%
Differential Phase			± 10 degrees
Headend Input Level-Outbound	+54 dBmV	+54 dBmV	
User Outlet Level-Outbound		+10 dBmV	≥0 dBmV & ≥3.0 dBmV @ 100′ Drop
User Input Level-Inbound	+54 dBmV	+54 dBmV	
Path Loss - Outbound	44 ± 5 dB	44 ± 3 dB Design Accept 44 ± 6 dB Oper.	
Path Loss- Inbound	44 ± 5 dB	Same as Outbound	
CNR - Outbound	43 dB	43 dB	43 dB
CNR - Inbound	41 dB	40 dB	
CTB - Outbound		53 dB	51 dB (47 dB HRC)
CTB - Inbound		53 dB	
CSO - Outbound			51 dB (47 dB HRC)
3 IM - Outbound	78 dB	60 dB @ 66 dBmV Input	51 dB (47 dB HRC)
3 IM - Inbound	78 dB	60 dB @ 66 dBmV Input	
2 IM - Outbound	60 dB	60 dB	51 dB (47 dB HRC)
2 IM - Inbound	60 dB	60 dB	
X-MOD; Outbound		53 dB	
X-MOD - Inbound		53 dB	
Hum Distortion (Incidental Modulation)	2%	1.5% (37 dB)	3%

* MAP = Manufacturing Automation Protocol (based on Token Bus - IEEE 802.4)

Broadband Communication Design & Performance Standards

Parameter	IEEE 802.7	MAP*	FCC
Signal Leakage 54 MHz 54 to 216 MHz >216 MHz	76.605(a)12 15 µV/m @ 30 m 20 µV/m @ 3 m	 same 15 µV/m @ 30 m	 same
Frequency Response- Peak to Valley 1 MHz 6 MHz 12 MHz 18 MHz	 0.17 dB 1.0 dB 1.5 dB 2.0 dB	 1.5 dB 2.0 dB 2.0 dB	 ± 2 dB ≤ 3.0 dB between adjc. carriers
Entire inbound or outbound frequency range		≤ 3 dB or N/1 0 + 1.5 dB	≤10 dB/300 MHz ≤11 dB/400 MHz ≤12 dB/500 MHz etc.
Return Loss Amplifiers/Passives 16 dB Semi-rigid coaxial cable reel 30 dB Semi-rigid coaxial cable 26 dB installed 26 dB Flexible coaxial cable, reel 26 dB Flexible coaxial cable, installed		16 dB	
Isolation Outlet to Outlet 25 dB		25 dB @ > 10 MHz	18 dB

* MAP = Manufacturing Automation Protocol (based on Token Bus - IEEE 802.4)

Wavelength & Antennas

1. Vertical antenna separation

Antennas for different frequencies mounted on a common mast should be separated by at least the length of the longest element of the largest antenna.

2. Wavelength in inches is given by:

$$\lambda\,(\text{in}) = \frac{11{,}811}{F\,(\text{MHz})}$$

3. Approximate length of a quarter wave whip antenna in inches is given by:

l = Wavelength
F = Frequency, MHz

$$\frac{\lambda}{4} = \frac{2775}{F}$$

4. Distance to the horizon is given by:

$$\text{Optical} \quad D = 1.23\sqrt{H}$$
$$\text{Radio} \quad D = 1.41\sqrt{H}$$

Assume smooth earth D = Distance, statute miles
H = Height, feet

5. Maximum Line of Sight is Given by:

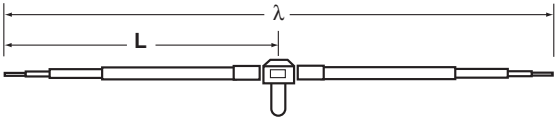
$$\text{Optical} \quad D = 1.23\sqrt{H}$$
$$\text{Radio} \quad D = 1.41\sqrt{H}$$

6. Radio Frequency Propagation

In free space, it is approximately 186,000 mi/sec or 982 ft/msec. Multiply by the velocity of propagation to determine the distance in coaxial cable.

Dipole Antenna Equations

Shown below is a typical half-wave dipole antenna. The radiation pattern of a Hertz dipole antenna is perpendicular to the axis of the antenna. In directions other than the optimum directions, the antenna is ineffective.



To calculate the wavelength of a signal, l or the dipole length, L, or the frequency, f, of a half-wave dipole antenna, use the following three formulas:

$$\lambda = \frac{kc}{f}$$

$$L = \frac{\lambda}{2}$$

$$f = \frac{kc}{\lambda}$$

where:

l = Wavelength (m)

k = Velocity Factor

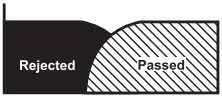
c = Speed of light = 3×10^8 (m/s)

f = Frequency (Hz)

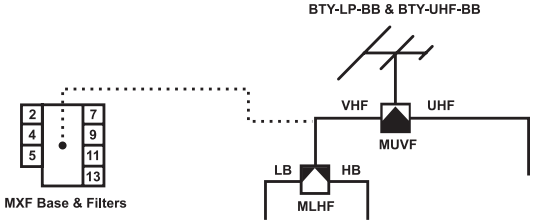
L = Length of the Dipole (m)

Multiplexers

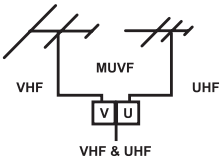
Low Pass Filter



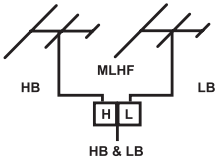
High Pass Filter



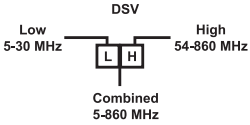
MXF Base & Filters



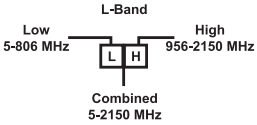
VHF & UHF



HB & LB



Combined
5-860 MHz



Combined
5-2150 MHz

Antenna General Information

Factors Which Determine The Quality Of Reception:

A) Distance to transmitter
B) Height of transmitting antenna
C) Transmitter power
D) Transmitter frequency (TV channel)
E) Type of receiving antenna
F) Height of receiving antenna
G) Terrain between the transmitter and receiving antenna
H) Obstacles between the transmitter and receiving antenna (tall buildings, water tower, etc.)

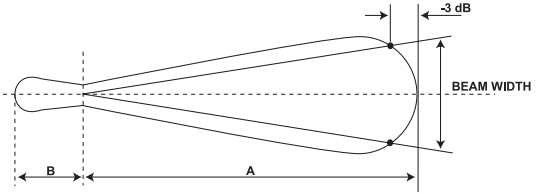
Major Characteristics:

Gain: Indicates the amount of received signal level increase as compared to reference antenna. (usually a resonant dipole)

Bandwidth: The range of frequencies (TV channels) over which the antenna is designed to operate. In principle, there are two types of antennas:
1) Broadband
2) Single-Channel

Impedance: Home type antennas are usually 300 Ohms and commercial antennas are usually 75 Ohms.

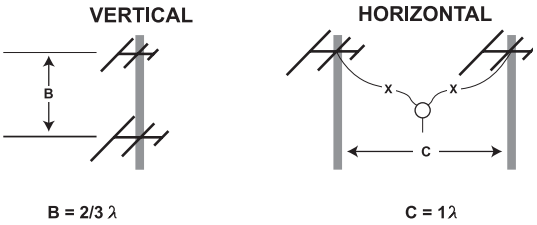
Pattern: Generally consists of two components, beam width and front to back ratio. Refer to diagram.

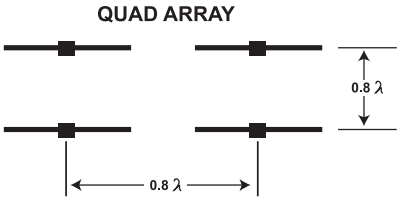


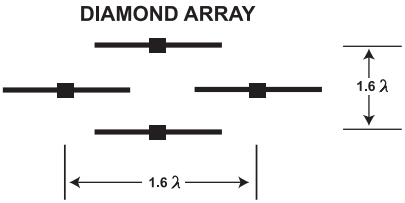
FRONT TO BACK RATIO = A - B

Antenna Stacking

Methods to Increase Received Signal Level



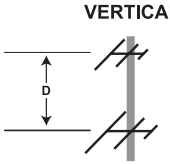


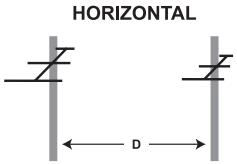


NOTE: Refer to Antenna Spacing Chart for dimensions

Antenna Spacing

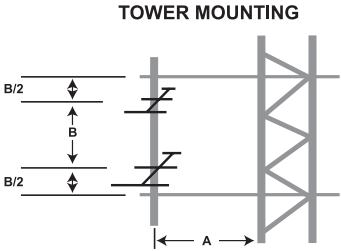
Mounting Channelized Antennas on the Same Mast





D = Min. 1/2 λ of lower channel
Optimum is 2/3 λ of lower channel

D = .12λ min. of lower channel



NOTE: Refer to Antenna Spacing Chart for dimensions

Antenna Spacing Chart

Dimension Notes:

A) The minimum horizontal spacing between the tower structure and the antenna crossbar.

B) The recommended vertical spacing for a gain of 3 dB.

Channel No.	A	B 2/3 λ	C 1 λ	D 1/2 λ
2	113	138	208	104
3	101	125	188	94
4	91	115	172	86
5	78	100	150	75
6	72	93	139	70
FM	72	80	120	60
7	40	44	67	33
8	39	43	65	32
9	37	42	62	31
10	36	40	61	30
11	35	39	59	29
12	34	38	57	29
13	34	37	55	28

Dimensions are in inches

B/2) The minimum vertical spacing between the antenna crossbar and adjacent mechanical structures.

C) The recommended horizontal spacing for a gain of 3 dB.

D) The minimum spacing between antennas of different channels and is the figure given for the antenna with the lowest frequency

Formulae:

One Wavelength in space . . . . . λ (inches) = $\frac{11811}{\text{Freq. in MHz}}$

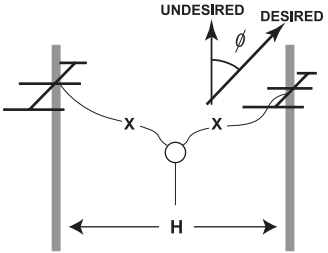
One Wavelength in 75 Ohm coax (solid) λ (inches) = $\frac{7783}{\text{Freq. in MHz}}$

One Wavelength in 75 Ohm coax (foam) . . . . λ (inches) = $\frac{9565}{\text{Freq. in MHz}}$

Antenna Nulling (finding H) . . . . . d (λ) = $\frac{1}{2 \sin \phi}$

Antenna Phasing

Signal Nulling



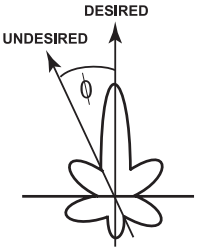


Chart No. II

ϕ°	λ(inches)
2	208
3	188
4	172
5	150
6	139
FM	120
7	67
8	65
9	62
10	61
11	59
12	57
13	55

Chart No. III

ϕ°	d(λ)	ϕ°	d(λ)
5	5.733	50	0.653
10	2.880	55	0.610
15	1.931	60	0.577
20	1.462	65	0.551
25	1.183	70	0.532
30	1.000	75	0.517
35	0.871	80	0.507
40	0.777	85	0.502
45	0.707	90	0.500

Instructions:

1. Determine angle "ϕ" using a field strength meter, compass, and a single channel antenna.
2. Locate angle "ϕ" in chart No. III and determine d(λ); multiply λ(inches) in chart No. II to find the spacing of "H".
3. Both antennas must be identical, facing in the same direction, in the same horizontal plane and both be right side up.
4. For angles not listed, $d(\lambda) = \frac{1}{2 \sin(\phi)}$

Pre-Amp Noise Figure vs. Carrier To Noise (4 MHz BW)

Input Signal Level	Noise Figure (dB) 2	3	4	5	6	7	8	9	10
-30	27	26	25	24	23	22	21	20	19
-29	28	27	26	25	24	23	22	21	20
-28	29	28	27	26	25	24	23	22	21
-27	30	29	28	27	26	25	24	23	22
-26	31	30	29	28	27	26	25	24	23
-25	32	31	30	29	28	27	26	25	24
-24	33	32	31	30	29	28	27	26	25
-23	34	33	32	31	30	29	28	27	26
-22	35	34	33	32	31	30	29	28	27
-21	36	35	34	33	32	31	30	29	28
-20	37	36	35	34	33	32	31	30	29
-19	38	37	36	35	34	33	32	31	30
-18	39	38	37	36	35	34	33	32	31
-17	40	39	38	37	36	35	34	33	32
-16	41	40	39	38	37	36	35	34	33
-15	42	41	40	39	38	37	36	35	34
-14	43	42	41	40	39	38	37	36	35
-13	4	43	42	41	40	39	38	37	36
-12	45	44	43	42	41	40	39	38	37
-11	46	45	44	43	42	41	40	39	38
-10	47	46	45	44	43	42	41	40	39
-9	48	47	46	45	44	43	42	41	40
-8	49	48	47	46	45	44	43	42	41
-7	50	49	48	47	46	45	44	43	42
-6	51	50	49	48	47	46	45	44	43
-5	52	51	50	49	48	47	46	45	44
-4	53	52	51	50	49	48	47	46	45
-3	54	53	52	51	50	49	48	47	46
-2	55	54	53	52	51	50	49	48	47
-1	56	55	54	53	52	51	50	49	48
0	57	56	55	54	53	52	51	50	49
1	58	57	56	55	54	53	52	51	50
2	59	58	57	56	55	54	53	52	51
3	60	59	58	57	56	55	54	53	52
4	61	60	59	58	57	56	55	54	53
5	62	61	60	59	58	57	56	55	54
6	63	62	61	60	59	58	57	56	55
7	64	63	62	61	60	59	58	57	56
8	65	64	63	62	61	60	59	58	57
9	66	65	64	63	62	61	60	59	58
10	67	66	65	64	63	62	61	60	59

TASO (TELEVISION ALLOCATION STUDY ORGANIZATION) GRADES

EXCELLENT	**46 dB**
FINE	**36 dB**
PASSABLE	**30 dB**
MARGINAL	**25 dB**
INFERIOR	**19 dB**

A SNR OF 36 dB MEANS A FINE PICTURE TO AN AVERAGE VIEWER,

A 30 dB RATIO MEANS A PASSABLE PICTURE AND SO ON.

Headend HVAC Considerations

To maximize equipment reliability and life span, the headend room should be temperature controlled. The heat generated by the headend is one of the major contributors to the total amount of BTU's required for heating and cooling. The specified AC wattage dissipation of a headend component directly correlates to the amount of heat it generates. The conversion from watts to the amount of heat generated in BTU's is as follows:

Watts x 3.4144 = BTU's/hour

With the total BTU's per hour the headend generates along with the buildings room details, a qualified HVAC technician can determine the necessary heating and cooling requirements..

Sample Headend BTU Calculations

# of Units	Model/St.#/Description	Watts	Total Watts	Conversion Factor	Total BTU/hr	
6	CAP-60 St.# 5894 (+60 dBmV UHF Proc.)	22	132.0	x 3.4144 =	450.7	
72	MAVM-60-861 St.# 7977 (+60 dBmV Modulator)	9	648.0	x 3.4144 =	2212.5	
6	QTRA-8 St.# 6230 (QPSK/QAM Transcoder)	87	522.0	x 3.4144 =	1782.0	
6	SAIP-60 St.# 5876 (+60 dBmV UHF Proc.)	18	108.0	x 3.4144 =	368.8	
		Total Watts	1410.0	x 3.4144 =	4814.3	Total BTU's
				(Divide By)	12000	
					.40	BTU (Tons)

System Planning

Headend & Distribution System Construction

The System Contractor must adhere to both national and local building codes when constructing a Broadband CATV System. This includes, but is not limited to the NEC, NFPA Codes and local building ordinances.

Related National Electrical Code (NEC) Articles

Article 250 - Grounding is one of the largest, most important, and least understood articles in the NEC. As specified in Section 90-1(a), safety is the key element and purpose of the NEC. Proper grounding and bonding is essential for maximum protection of life and property. If over-current protection is considered the first line of defense, grounding could be considered the last line of defense.

Article 810 - Radio and Television Equipment covers radio and television receiving equipment and amateur radio transmitting and receiving equipment, but not equipment and antennas used for coupling carrier current to power line conductors.

Article 820 - Community Antenna Television and Radio Distribution Systems covers coaxial cable distribution of radio frequency signals typically employed in community antenna television (CATV) systems.

National Fire Protection Agency (NFPA) - www.nfpa.org

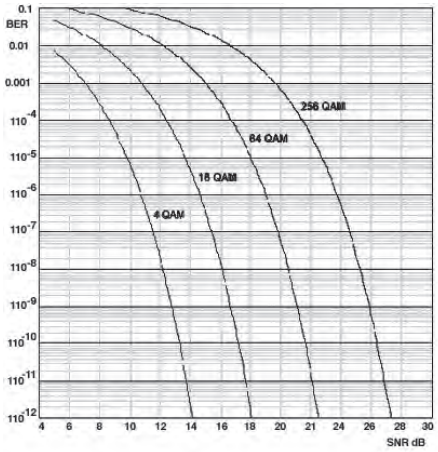
Digital Signal Analysis

Digital signals such as QPSK & QAM use many different factors to determine the quality and performance of the signal. The following section will describe some of the most common factors used in digital signal analysis.

QAM Signal to Noise Ratio vs. BER

The theoretical bit-error rate of the QAM signal as a function of the SNR is provided for reference.

To obtain an estimated BER of the QAM signal, one can use the following diagram to get theoretical values for BER. In the case that the QAM 64 mode SNR is >32, it indicates 10-12 BER. It should be noted that changing the S/N value by as little as 1 dB alters approximately one decade. The diagram below depicts the theoretical BER vs. SNR.



QAM Signal to Noise Ratio

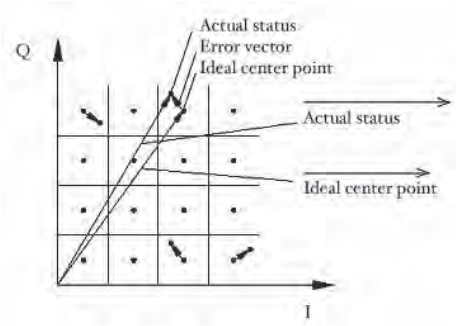
The following table depicts the theoretical maximum values for various orders of QAM:

Order of QAM	SNR max
4	46.0 dB
16	46.0 dB
32	43.0 dB
64	46.0 dB
128	43.0 dB
256	46.0 dB

QAM MER — Modulation Error Ratio

The modulation error is a calculated quantity indicating the mean or the maximum deviation of the I/Q values from ideal signal states and thus provides a measure of signal quality.

The following diagram shows the vectors used for calculating the modulation error:



The modulation error is specified as rms and as peak value. To calculate the modulation error, all decisions fields are investigated on after the other:

To obtain peak modulation error, the maximum magnitude of the difference vector (error vector) formed by the vector of the ideal and the actual signal status is determined for each decision field. From the maximum value of these results, the peak MER (modulation error ratio) is calculated using the following formula:

$$MER_{PEAK} = 100 \cdot \frac{\max\{|error\ vector|\}}{\overline{VM}} [\%]$$

To obtain the rms modulation error, the squares of the magnitude of all differential vectors formed by the ideal-status and actual-status vectors are added up, and the number of symbols is counted. Then the rms modulation error is calculated as follows:

$$MER_{RMS} = 100 \cdot \frac{\sqrt{\frac{1}{n}\sum_{n}|error\ vector|^2}}{\overline{VM}} [\%]$$

The peak and rms modulation error can also be specified on a logarithmic scale. Conversion is done using the following formula:

$$MER_{dB} = 20 \cdot \lg\left(\frac{MER\ [\%]}{100}\right)\ [dB]$$

Digital Signal Analysis

For quantized I/Q values, the peak value is output in discrete form only since no averaging is performed in the calculation. The rms modulation error can be calculated within the limit values specified in the following table. The limit values are obtained for quantized I/Q values:

Order of QAM	MER_{RMS} min	MER_{PK} min	MER_{PK} min	MER_{dB} max
4	0.5 %	1.563 %	98.44 %	46 dB
16	0.5 %	1.398 %	43.32 %	46 dB
32	0.7 %	1.976 %	29.33 %	43 dB
64	0.5 %	1.364 %	20.46 %	46 dB
128	0.7 %	1.952 %	13.66 %	43 dB
256	0.5 %	1.356 %	9.471 %	46 dB

The term “Modulation Error Ratio” and the prescribed method of calculation were declared an international standard by the DVB Measurement Group.

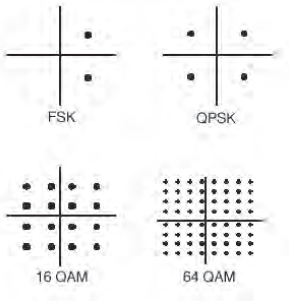
Digital Signal Analysis

What is a QAM Signal

Quadrature Amplitude Modulation (QAM) uses many different phases known as states: 16, 32, 64, and 256. Each state is defined by a specific amplitude and phase. This means the generation and detection of symbols is more complex than a simple phase or amplitude device. Each time the number of states per symbol is increased the total data and bandwidth increases. The modulation schemes shown occupy the same bandwidth (after filtering), but have varying efficiencies (in theory at least).

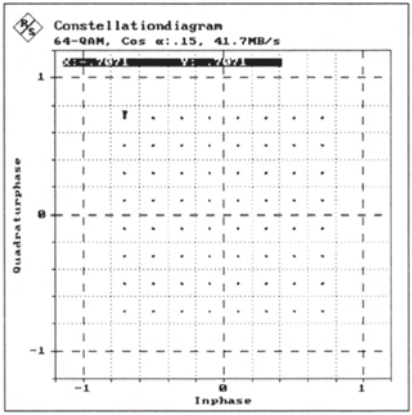
QAM — Constellation Diagrams

Constellation diagrams are used to graphically represent the quality and distortion of a digital signal. In practice, there is always a combination of modulation errors that may be difficult to separate and identify, as such, it is recommended to evaluate the measured constellation diagrams using mathematical and statistically methods. The following section will provide application and interpretation information of constellation diagrams of digital modulated signals.



Digital Signal Analysis

The constellation diagram examples shown are based on 64 QAM modulation and use the following basic settings: maximum possible DVB data transmission rate of 6.92 Msps or 41.73 Mbit/s (64 QAM); Cosine roll-off filtering with roll-off factor r = 0.15 and PRBS (pseudo random binary sequence) data stream, no coding.



Constellation Diagram for an Ideal 64 QAM Signal

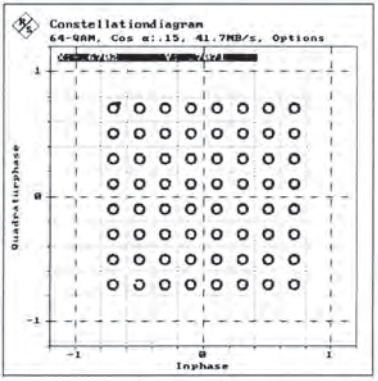
Amplitude Imbalance describes the different gains of the I and Q components of a signal. In a constellation diagram, amplitude imbalance shows by one signal component being expanded and the other one being compressed. This is due to the fact that the receiver AGC makes a constant average signal level.

Phase Error is the difference between the phase angles of the I and Q components referred to 90°. A phase error is caused by an error of the phase shifter of the I/Q modulator. The I and Q components are in this case not orthogonal to each other after demodulation.

Digital Signal Analysis

Interferers are understood to be sinusoidal spurious signals occurring in the transmission frequency range and superimposed on the QAM signal at some point in the transmission path. After demodulation, the interferer is contained in the baseband form of low-frequency sinusoidal spurious signals. The frequency of these signals corresponds to the difference between the frequency of the original sinusoidal interference and the carrier frequency in the RF band.

In the constellation diagram, an interferer shows in the form of a rotating pointer superimposed on each signal status. The example applies the condition that there is no other error present at the same time, The constellation diagram shows the path of the pointer as a circle around each ideal signal status.

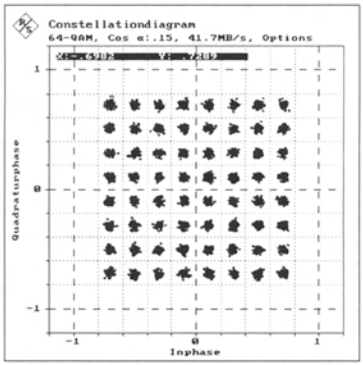


Constellation Diagram — 64 QAM signal with Interferer (C/I = 25.0 dB)

Digital Signal Analysis

Carrier suppression or leakage is a special type of interference in which it's frequency equals the carrier frequency in the RF channel. Carrier leakage can be superimposed on the QAM signal in the I/Q modulator. In the constellation diagram, carrier leakage shows up as a shifting of the signal states corresponding to the DC components of the I and Q components.

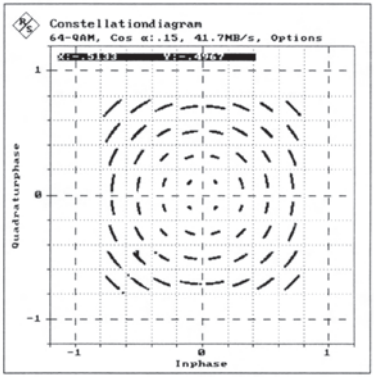
Additive Gaussian noise can disturb the digitally modulated signal during analog transmission, for instance in the analog channel. Additive superimposed noise normally has a constant power density and a Gaussian amplitude distribution throughout the bandwidth of a channel. If no other error is present at the same time, the points representing the ideal signal status are expanded to form circular "clouds".



Constellation Diagram — 64 QAM signal with Additive Noise (SNR = 30.0 dB)

(**Note:** This diagram may also be obtained for other types of interference so that a distinction from noise-produced patterns cannot be made)

Phase Jitter or phase noise in the QAM signal is caused by transponders in the transmission path or by the I/Q modulator. It may be produced in carrier recovery, a possibility that is to be excluded here. In contrast to the phase error described above, phase jitter is a statistical quantity that affects the I and Q path equally. In the constellation diagram, phase jitter shows up by the signal states being shifted about their coordinate origin.



Constellation Diagram — 64 QAM signal with Phase Jitter (PJRMS = 1.73°)

Source: Rohde & Schwarz — EFA QAM Analyzer documentation

Station List

Prior to the digital transition date of February 17, 2009 the FCC assigned interim "Companion DTV" channel assignments to all eligible full power TV stations. The companion channels enabled the broadcasters to begin delivering digital programming simultaneously along with their original analog broadcasts.

The FCC subsequently released the "Final DTV" channel allotments on March 21, 2008. The final DTV channels are the RF channels that will be used post transition (after February 17, 2009). The Final DTV assignments reflect the new core spectrum for TV broadcasts of channels 2 to 51. Channels 52 to 69 have been re-assigned for public safety and advanced wireless services.

The former analog channel number information will be carried in the new digital channel's PSIP (Program and System Information Protocol) information. It may also be referred to as the "tune to" (NAB) or as a "virtual" channel. Digital TV's and STB's use this channel number to tune to the particular program that in most cases is transmitted over a completely different RF channel. *Refer to the DTV Companion or Final DTV columns on the preceding station list tables for actual RF channels used.*

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
AK	**ANCHORAGE**	**KTUU-TV**	**2**	**10**	**10**	**NBC**
AK	ANCHORAGE	KTBY	4	20	20	FOX
AK	ANCHORAGE	KYES-TV	5	6	5	My TV
AK	ANCHORAGE	KAKM	7	8	8	PBS
AK	ANCHORAGE	CP	9	26	26	PBS
AK	ANCHORAGE	KTVA	11	28	28	CBS
AK	ANCHORAGE	KIMO	13	12	12	ABC
AK	ANCHORAGE	KDMD	33	32	32	ION
AK	BETHEL	KYUK	4	3	3	IND
AK	FAIRBANKS	KATN	2	18	18	IND
AK	FAIRBANKS	KFXF-TV	7	22	7	FOX
AK	FAIRBANKS	KUAC-TV	9	24	9	PBS
AK	FAIRBANKS	KTVF	11	26	26	NBC
AK	JUNEAU	KTOO-TV	3	10	10	PBS
AK	JUNEAU	KJUD	8	11	11	IND
AK	KETCHIKAN	KUBD	4	13	13	ION

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
AK	NORTH POLE	KJNP-TV	4	20	20	IND
AK	SITKA	KTNL	13	2	7	CBS
AL	**ANNISTON**	**WJSU-TV**	**40**	**9**	**9**	**ABC**
AL	BESSEMER	WDBB	17	18	18	CW
AL	BIRMINGHAM	WBRC	6	50	50	FOX
AL	BIRMINGHAM	WBIQ	10	53	10	PBS
AL	BIRMINGHAM	WVTM-TV	13	52	13	NBC
AL	BIRMINGHAM	WIAT	42	30	30	CBS
AL	BIRMINGHAM	WABM-TV	68	36	36	My TV
AL	DEMOPOLIS	WIIQ	41	19	19	PBS
AL	DOTHAN	WTVY-TV	4	36	36	CBS
AL	DOTHAN	WDHN	18	21	21	ABC
AL	DOZIER	WDIQ	2	11	10	PBS
AL	FLORENCE	WHDF	15	14	14	CW
AL	FLORENCE	WYLE	26	20	20	IND
AL	FLORENCE	WFIQ	36	22	22	PBS
AL	GADSDEN	WPXH	44	45	45	ION
AL	GADSDEN	WTJP	60	26	26	REL
AL	GULF SHORES	WBPG	55	12	25	CW
AL	HOMEWOOD	WTTO	21	28	28	CW
AL	HUNTSVILLE	WHNT-TV	19	59	19	CBS
AL	HUNTSVILLE	WHIQ	25	24	24	PBS
AL	HUNTSVILLE	WAAY-TV	31	32	32	ABC
AL	HUNTSVILLE	WAFF	48	49	49	NBC
AL	HUNTSVILLE	WZDX	54	41	41	FOX
AL	LOUISVILLE	WGIQ	43	44	44	PBS
AL	MOBILE	WKRG-TV	5	27	27	CBS
AL	MOBILE	WALA-TV	10	9	9	FOX
AL	MOBILE	WPMI	15	47	15	NBC
AL	MOBILE	WMPV-TV	21	20	20	IND
AL	MOBILE	WEIQ	42	41	41	PBS
AL	MOBILE	WDPM		23	23	CP
AL	MONTGOMERY	WSFA	12	14	12	NBC
AL	MONTGOMERY	WCOV-TV	20	16	16	FOX
AL	MONTGOMERY	WAIQ	26	27	27	PBS
AL	MONTGOMERY	WNCF-TV	32	51	32	ABC
AL	MONTGOMERY	WMCF-TV	45	46	46	REL

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
AL	MT. CHEAHA	WCIQ	7	56	7	PBS
AL	OPELIKA	WLGA	66	31	47	CW
AL	OZARK	WDFX-TV	34	33	33	FOX
AL	SELMA	WAKA	8	55	42	CBS
AL	SELMA	WBIH	29	29	29	IND
AL	TROY	WRJM	67	48	48	IND
AL	TUSCALOOSA	WUOA	23	6	6	ED
AL	TUSCALOOSA	WCFT-TV	33	5	33	ABC
AL	TUSKEGEE	WBMM	22	24	22	IND
AR	**ARKADELPHIA**	**KETG**	**9**	**13**	**13**	**PBS**
AR	CAMDEN	KKYK-DT	49	49	49	IND
AR	EL DORADO	KTVE	10	27	27	NBC
AR	EL DORADO	KEJB	43	43	43	IND
AR	EL DORADO	KETZ		12	10	PBS
AR	EUREKA SPR.	KPBI	34	34	34	IND
AR	FAYETTEVILLE	KAFT	13	9	9	PBS
AR	FAYETTEVILLE	KHOG-TV	29	15	15	ABC
AR	FORT SMITH	KFSM-TV	5	18	18	CBS
AR	FORT SMITH	KFTA-TV	24	27	27	NBC
AR	FORT SMITH	KHBS	40	21	21	ABC
AR	HARRISON	KWBM	31	31	31	IND
AR	HOT SPRINGS	KVTH	26	26	26	REL
AR	JONESBORO	KAIT-TV	8	9	8	ABC
AR	JONESBORO	KTEJ	19	20	20	PBS
AR	JONESBORO	KVTJ	48	48	48	REL
AR	LITTLE ROCK	KETS	2	5	7	PBS
AR	LITTLE ROCK	KARK-TV	4	32	32	NBC
AR	LITTLE ROCK	KATV	7	22	22	ABC
AR	LITTLE ROCK	KTHV	11	12	12	CBS
AR	LITTLE ROCK	KLRT	16	30	30	FOX
AR	LITTLE ROCK	KKAP	36	36	36	ED
AR	LITTLE ROCK	KWBF	42	44	44	My TV
AR	MOUNT. VIEW	KEMV	6	13	13	PBS
AR	PINE BLUFF	KVTN	25	24	24	IND
AR	PINE BLUFF	KASN	38	39	39	CW
AR	ROGERS	KNWA-TV	51	50	50	NBC
AR	SPRINGDALE	KWOG	57	39	39	IND

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
AZ	**DOUGLAS**	**KFTU**	**3**	**36**	**36**	**TLF**
AZ	FLAGSTAFF	KNAZ-TV	2	22	2	NBC
AZ	FLAGSTAFF	KTFL	4	18	18	IND
AZ	FLAGSTAFF	KCFG	9	32	32	IND
AZ	FLAGSTAFF	KFPH	13	27	13	TLF
AZ	GREEN VAL.	KUVE-TV	46	47	46	UNV
AZ	HOLBROOK	KDTP	11	11	11	ED
AZ	KINGMAN	KMOH	6	19	19	IND
AZ	MESA	KPNX-TV	12	36	12	NBC
AZ	PHOENIX	KTVK-TV	3	24	24	IND
AZ	PHOENIX	KPHO-TV	5	17	17	CBS
AZ	PHOENIX	KAET	8	29	8	PBS
AZ	PHOENIX	KSAZ-TV	10	31	10	FOX
AZ	PHOENIX	KNXV	15	56	15	ABC
AZ	PHOENIX	KPAZ-TV	21	20	20	REL
AZ	PHOENIX	KTVW-TV	33	34	33	UNV
AZ	PHOENIX	KMCT-TV	39	38	39	IND
AZ	PHOENIX	KUTP	45	26	26	My TV
AZ	PHOENIX	KASW	61	49	49	CW
AZ	PRESCOTT	KAZT-TV	7	25	7	IND
AZ	SIERRA VISTA	KWBA	58	44	44	CW
AZ	TOLLESON	KPPX	51	52	51	ION
AZ	TUCSON	KVOA	4	23	23	NBC
AZ	TUCSON	KUAT-TV	6	30	30	PBS
AZ	TUCSON	KGUN-TV	9	35	9	ABC
AZ	TUCSON	KMSB-TV	11	25	25	FOX
AZ	TUCSON	KOLD-TV	13	32	32	CBS
AZ	TUCSON	KTTU-TV	18	19	19	My TV
AZ	TUCSON	KUAS-TV	27	28	28	PBS
AZ	TUCSON	KHRR	40	42	40	TLM
AZ	YUMA	KYMA	11	41	11	NBC
AZ	YUMA	KSWT-TV	13	16	16	CBS
CA	**ANAHEIM**	**KDOC-TV**	**56**	**32**	**32**	**IND**
CA	ARCATA	KAEF	23	22	22	ABC
CA	AVALON	KAZA-TV	54	47	47	Azteca
CA	BAKERSFIELD	KGET	17	25	25	NBC
CA	BAKERSFIELD	KERO-TV	23	10	10	ABC

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
CA	BAKERSFIELD	KBAK-TV	29	33	33	CBS
CA	BAKERSFIELD	KUVI-TV	45	55	45	My TV
CA	BARSTOW	KHIZ	64	44	44	IND
CA	BISHOP	KBBC	20	20	20	IND
CA	CALIPATRIA	KAJB	54	36	36	IND
CA	CERES	KBSV	23	15	15	
CA	CHICO	KHSL-TV	12	43	43	CBS
CA	CHICO	KNVN	24	36	24	NBC
CA	CLOVIS	KGMC	43	44	43	IND
CA	CONCORD	KTNC-TV	42	63	14	Azteca
CA	CORONA	KVEA	52	39	39	TLM
CA	COTATI	KRCB	22	23	23	PBS
CA	EL CENTRO	KVYE	7	22	22	UNV
CA	EL CENTRO	KECY	9	48	9	FOX
CA	EUREKA	KIEM-TV	3	16	3	NBC
CA	EUREKA	KVIQ-TV	6	17	17	CBS
CA	EUREKA	KEET	13	11	11	PBS
CA	EUREKA	KBVU	29	28	28	FOX
CA	FORT BRAGG	KUNO	8	15	8	IND SP
CA	FRESNO	KVPT	18	40	40	PBS
CA	FRESNO	KSEE	24	38	38	NBC
CA	FRESNO	KCVU	30	20	30	FOX
CA	FRESNO	KFSN-TV	30	9	30	ABC
CA	FRESNO	KGPE	47	34	34	CBS
CA	FRESNO	KAIL	53	7	7	My TV
CA	HANFORD	KFTV	21	20	20	UNV
CA	HUNT. BEACH	KOCE-TV	50	48	48	PBS
CA	LONG BEACH	KSCI	18	61	18	IND
CA	LOS ANGELES	KCBS	2	60	43	CBS
CA	LOS ANGELES	KNBC	4	36	36	NBC
CA	LOS ANGELES	KTLA	5	31	31	CW
CA	LOS ANGELES	KABC-TV	7	53	7	ABC
CA	LOS ANGELES	KCAL-TV	9	43	9	IND
CA	LOS ANGELES	KTTV	11	65	11	FOX
CA	LOS ANGELES	KCOP	13	66	13	My TV
CA	LOS ANGELES	KWHY-TV	22	42	42	IND
CA	LOS ANGELES	KCET	28	59	28	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
CA	LOS ANGELES	KMEX-TV	34	35	34	UNV
CA	LOS ANGELES	KLCS	58	41	41	PBS
CA	MERCED	KNSO	51	5	11	TLM
CA	MODESTO	KUVS	19	18	18	UNV
CA	MONTEREY	KION	46	32	32	CBS
CA	MONTEREY	KSMS-TV	67	31	31	UNV
CA	NOVATO	KTLN-TV	68	47	47	IND
CA	OAKLAND	KTVU	2	56	44	FOX
CA	ONTARIO	KFTR	46	29	29	TLF
CA	OXNARD	KBEH-TV	63	24	24	MTV
CA	PALM SPR.	KMIR-TV	36	46	46	NBC
CA	PALM SPR.	KESQ-TV	42	52	42	ABC
CA	PARADISE	KCVU	30	20	20	IND
CA	PORTERVILLE	KTFF	61	48	48	TLF
CA	RANCHO PALOS VERDES	KXLA	44	51	51	IND
CA	REDDING	KRCR-TV	7	34	7	IND
CA	REDDING	KIXE-TV	9	18	9	ED
CA	RIVERSIDE	KRCA-TV	62	68	45	IND
CA	SACRAMENTO	KCRA-TV	3	35	35	NBC
CA	SACRAMENTO	KVIE	6	53	9	PBS
CA	SACRAMENTO	KXTV	10	61	10	ABC
CA	SACRAMENTO	KSPX	29	48	48	ION
CA	SACRAMENTO	KMAX-TV	31	21	21	CW
CA	SACRAMENTO	KTXL	40	55	40	FOX
CA	SALINAS	KSBW	8	10	8	NBC
CA	SALINAS	KCBA	35	13	13	FOX
CA	SAN BERN.	KVCR-TV	24	26	26	PBS
CA	SAN BERN.	KPXN	30	38	38	ION
CA	SAN DIEGO	KFMB-TV	8	55	8	CBS
CA	SAN DIEGO	KGTV	10	25	10	ABC
CA	SAN DIEGO	KPBS	15	30	30	PBS
CA	SAN DIEGO	KNSD	39	40	40	NBC
CA	SAN DIEGO	KUSI-TV	51	18	18	IND
CA	SAN DIEGO	KSWB-TV	69	19	19	CW
CA	SAN FRAN.	KRON-TV	4	57	38	My TV
CA	SAN FRAN.	KPIX	5	29	29	CBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
CA	SAN FRAN.	KGO-TV	7	24	7	ABC
CA	SAN FRAN.	KQED	9	30	30	PBS
CA	SAN FRAN.	KDTV-TV	14	51	51	UNV
CA	SAN FRAN.	KBWB	20	19	19	IND
CA	SAN FRAN.	KTSF	26	27	27	IND
CA	SAN FRAN.	KMTP-TV	32	33	33	ED
CA	SAN FRAN.	KCNS-TV	38	39	39	IND
CA	SAN FRAN.	KBCW	44	45	45	CW
CA	SAN JOSE	KNTV-TV	11	12	12	NBC
CA	SAN JOSE	KICU-TV	36	52	36	IND
CA	SAN JOSE	KSTS	48	49	49	TLM
CA	SAN JOSE	KTEH	54	50	50	PBS
CA	SAN JOSE	KKPX	65	41	41	ION
CA	SAN LUIS OBISPO	KSBY	6	15	15	NBC
CA	SAN LUIS OBISPO	KTAS	33	34	34	TLM
CA	SAN MATEO	KCSM-TV	60	43	43	PBS
CA	SANGER	KFRE-TV	59	36	36	CW
CA	SANTA ANA	KTBN-TV	40	23	23	REL
CA	SANTA BARB.	KEYT-TV	3	27	27	ABC
CA	SANTA BARB.	KPMR	38	21	21	UNV
CA	SANTA MARIA	KCOY-TV	12	19	19	CBS
CA	SANTA ROSA	KFTY	50	54	32	IND
CA	STOCKTON	KOVR-TV	13	25	25	CBS
CA	STOCKTON	KQCA	58	46	46	My TV
CA	STOCKTON	KTFK	64	62	26	TLF
CA	29 PALMS	KVMD-DT		23	23	IND
CA	VALLEJO	KFSF	66	34	34	TLF
CA	VENTURA	KJLA	57	49	49	IND
CA	VISALIA	KMPH-TV	26	28	28	FOX
CA	VISALIA	KNXT-TV	49	50	50	ED
CA	WATSONVILLE	KQET	25	58	25	PBS
CO	**BOULDER**	**KTFD-TV**	**14**	**15**	**15**	**TLF**
CO	BROOMFIELD	KBDI-TV	12	38	13	PBS
CO	CASTLE ROCK	KWHD	53	46	46	IND
CO	CO. SPRINGS	KKTV	11	10	10	My TV
CO	CO. SPRINGS	KRDO-TV	13	24	24	ABC
CO	CO. SPRINGS	KXRM-TV	21	22	22	FOX

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
CO	DENVER	KWGN-TV	2	34	34	CW
CO	DENVER	KCNC-TV	4	35	35	CBS
CO	DENVER	KRMA-TV	6	18	18	PBS
CO	DENVER	KMGH-TV	7	17	7	ABC
CO	DENVER	KUSA-TV	9	16	9	NBC
CO	DENVER	KTVD-TV	20	19	19	My TV
CO	DENVER	KDVR	31	32	32	FOX
CO	DENVER	KRMT	41	40	40	REL
CO	DENVER	KCEC	50	51	51	UNV
CO	DENVER	KPXC	59	43	43	ION
CO	DURANGO	KREZ-TV	6	15	15	CBS
CO	DURANGO	KTLL-TV	33	33	33	IND
CO	DURANGO	KRMU		20	20	PBS
CO	FT. COLLINS	KFCT	22	21	21	FOX
CO	FT. MORGAN	KUPN	3	23	23	My TV
CO	GLNWD. SPR.	KREG-TV	3	23	23	CBS
CO	GRAND JUNCT.	KFQX	4	15	15	FOX
CO	GRAND JUNCT.	KREX-TV	5	2	2	CBS
CO	GRAND JUNCT.	KJCT-TV	8	7	7	ABC
CO	GRAND JUNCT.	KKCO	11	12	12	NBC
CO	GRAND JUNCT.	KRMJ	18	17	18	PBS
CO	GREELEY	KPJR-TV	38	38	38	IND
CO	LONGMONT	KDEN-TV	25	29	29	TLM
CO	MONTROSE	KREY-TV	10	13	13	CBS
CO	PUEBLO	KOAA-TV	5	42	42	NBC
CO	PUEBLO	KTSC	8	26	8	PBS
CO	PUEBLO	KVSN		48	48	IND
CO	STMBOAT SPR.	KRMZ	24	10	10	PBS
CO	STERLING	KCDO	3	23	23	IND
CT	**BRIDGEPORT**	**WSAH**	**43**	**42**	**42**	**IND**
CT	BRIDGEPORT	WEDW	49	52	49	PSB
CT	HARTFORD	WFSB	3	33	33	CBS
CT	HARTFORD	WUVN-TV	18	46	46	UNV
CT	HARTFORD	WEDH	24	45	45	PBS
CT	HARTFORD	WTIC-TV	61	31	31	FOX
CT	NEW BRITAIN	WVIT	30	35	35	NBC
CT	NEW HAVEN	WTNH-TV	8	10	10	ABC

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
CT	NEW HAVEN	WCTX-TV	59	39	39	My TV
CT	NEW HAVEN	WEDY	65	6	6	PBS
CT	NEW LONDON	WHPX	26	34	26	ION
CT	NORWICH	WEDN	53	45	9	PBS
CT	WATERBURY	WTXX	20	12	20	CW
DC	**WASHINGTON**	**WRC-TV**	**4**	**48**	**48**	**NBC**
DC	WASHINGTON	WTTG-TV	5	36	36	FOX
DC	WASHINGTON	WJLA-TV	7	39	7	ABC
DC	WASHINGTON	WUSA	9	34	9	CBS
DC	WASHINGTON	WDCA	20	35	35	My TV
DC	WASHINGTON	WETA-TV	26	27	27	PBS
DC	WASHINGTON	WHUT-TV	32	33	33	ED
DC	WASHINGTON	WDCW	50	51	50	CW
DE	**SEAFORD**	**WDPB**	**64**	**44**	**44**	**PBS**
DE	WILMINGTON	WHYY-TV	12	12	12	PBS
DE	WILMINGTON	WPPX	61	31	31	ION
FL	**BOCA RATON**	**WBEC**	**63**	**40**	**40**	**ED**
FL	BRADENTON	WXPX	66	42	42	ION
FL	CAPE CORAL	WFTX	36	35	35	FOX
FL	CLEARWATER	WCLF	22	21	21	IND
FL	CLERMONT	WKCF	18	17	17	CW
FL	COCOA	WHLV-TV	52	51	51	REL
FL	COCOA	WBCC	68	30	30	PBS
FL	DAYTONA BCH.	WESH	2	11	11	NBC
FL	DAYTONA BCH.	WVEN	26	49	49	UNV
FL	DESTIN	WFBD DT		48	48	IND
FL	FT. LAUDER.	WSCV	51	52	30	TLM
FL	FORT MYERS	WINK-TV	11	9	9	CBS
FL	FORT MYERS	WBBH-TV	20	15	15	NBC
FL	FORT MYERS	WGCU-TV	30	31	31	PBS
FL	FORT PIERCE	WTCE	21	38	38	ED
FL	FORT PIERCE	WTVX	34	50	34	CW
FL	FT. WALTON BEACH	WFGX	35	50	50	My TV
FL	FT. WALTON BEACH	WPAN	53	40	40	IND
FL	FT. WALTON BEACH	WAWD	58	49	49	IND

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
FL	GAINESVILLE	WUFT	5	36	36	PBS
FL	GAINESVILLE	WCJB	20	16	16	ABC
FL	GAINESVILLE	WNBW	29	9	9	IND
FL	HIGH SPRINGS	WGFL	53	28	28	CBS
FL	HOLLYWOOD	WAMI-TV	69	47	47	TLF
FL	JACKSONVILLE	WJXT	4	42	42	IND
FL	JACKSONVILLE	WJCT	7	38	7	PBS
FL	JACKSONVILLE	WTLV	12	13	13	NBC
FL	JACKSONVILLE	WCWJ	17	34	34	CW
FL	JACKSONVILLE	WAWS-TV	30	32	32	FOX
FL	JACKSONVILLE	WTEV-TV	47	19	19	CBS
FL	JACKSONVILLE	WJEB-TV	59	44	44	PBS
FL	KEY WEST	WGEN-TV	8	12	8	IND SP
FL	KEY WEST	WSBS-TV	22	3	3	IND SP
FL	LAKE WORTH	WPXP	67	36	36	ION
FL	LAKELAND	WMOR-TV	32	19	19	IND
FL	LEESBURG	WTGL	45	46	46	REL
FL	LEESBURG	WACX	55	40	40	IND
FL	LIVE OAK	WFXU	57	48	48	CW
FL	MARIANNA	WBIF	51	51	51	CW
FL	MELBOURNE	WOTF	43	20	43	TLF
FL	MELBOURNE	WOPX	56	48	48	ION
FL	MIAMI	WPBT	2	18	18	PBS
FL	MIAMI	WFOR-TV	4	22	22	CBS
FL	MIAMI	WTVJ	6	31	31	NBC
FL	MIAMI	WSVN-TV	7	8	7	FOX
FL	MIAMI	WPLG	10	9	10	ABC
FL	MIAMI	WLRN-TV	17	20	20	PBS
FL	MIAMI	WLTV	23	24	23	UNV
FL	MIAMI	WBFS-TV	33	32	32	My TV
FL	MIAMI	WPXM	35	26	35	ION
FL	MIAMI	WSFL-TV	39	19	19	CW
FL	MIAMI	WHFT	45	46	46	IND
FL	NAPLES	WZVN-TV	26	41	41	ABC
FL	NAPLES	WXCW	46	45	45	CW
FL	NEW SMYRNA BEACH	WCEU	15	33	33	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
FL	OCALA	WOGX	51	31	31	FOX
FL	ORANGE PARK	WJXX	25	10	10	ABC
FL	ORLANDO	WKMG-TV	6	58	26	CBS
FL	ORLANDO	WFTV	9	39	39	ABC
FL	ORLANDO	WMFE-TV	24	23	23	PBS
FL	ORLANDO	WRDQ	27	14	27	IND
FL	ORLANDO	WOFL	35	22	22	FOX
FL	ORLANDO	WRBW	65	41	41	My TV
FL	PALM BEACH	WFGC-TV	61	49	49	IND
FL	PANAMA CITY	WJHG-TV	7	8	7	NBC
FL	PANAMA CITY	WMBB	13	19	13	ABC
FL	PANAMA CITY	WPGX	28	9	9	FOX
FL	PANAMA CITY	WFSG	56	38	38	PBS
FL	PANAMA CITY BEACH	WPCT	46	47	47	IND
FL	PENSACOLA	WEAR-TV	3	17	17	ABC
FL	PENSACOLA	WSRE	23	31	31	ED
FL	PENSACOLA	WHBR	33	34	34	IND
FL	PENSACOLA	WJTC	44	45	45	IND
FL	SARASOTA	WWSB	40	52	24	ABC
FL	ST. PETERS.	WTSP	10	24	10	CBS
FL	ST. PETERS.	WTTA	38	57	38	My TV
FL	ST. PETERS.	WTOG	44	59	44	CW
FL	STUART	WHDT		44	44	IND
FL	TALLAHASSEE	WFSU-TV	11	32	32	PBS
FL	TALLAHASSEE	WTXL-TV	27	22	27	ABC
FL	TALLAHASSEE	WTWC	40	2	40	NBC
FL	TALLAHASSEE	WTLF-DT		24	24	CW
FL	TAMPA	WEDU	3	54	13	PBS
FL	TAMPA	WFLA-TV	8	7	7	NBC
FL	TAMPA	WTVT	13	12	12	FOX
FL	TAMPA	WUSF-TV	16	34	34	PBS
FL	TAMPA	WFTS	28	29	29	ABC
FL	TAMPA	WFTT	50	47	47	TLF
FL	TEQUESTA	WPBF	25	16	16	ABC
FL	TICE	WRXY-TV	49	33	33	IND
FL	VENICE	WVEA-TV	62	25	25	UNV

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
FL	W. PALM BCH.	WPTV	5	55	12	NBC
FL	W. PALM BCH.	WPEC	12	13	13	CBS
FL	W. PALM BCH.	WFLX	29	28	28	FOX
FL	W. PALM BCH.	WXEL-TV	42	27	27	PBS
GA	**ALBANY**	**WALB-TV**	**10**	**17**	**10**	**NBC**
GA	ALBANY	WFXL	31	12	12	FOX
GA	ATHENS	WGTV	8	8	8	PBS
GA	ATHENS	WUVG-TV	34	48	48	UNV
GA	ATLANTA	WSB -TV	2	39	39	ABC
GA	ATLANTA	WAGA	5	27	27	FOX
GA	ATLANTA	WXIA-TV	11	10	10	NBC
GA	ATLANTA	WPCH-TV	17	20	20	IND
GA	ATLANTA	WPBA	30	21	21	PBS
GA	ATLANTA	WATL	36	25	25	My TV
GA	ATLANTA	WGCL	46	19	19	CBS
GA	ATLANTA	WATC	57	41	41	ED
GA	ATLANTA	WUPA	69	43	43	CW
GA	AUGUSTA	WJBF	6	42	42	ABC
GA	AUGUSTA	WRDW-TV	12	31	12	My TV
GA	AUGUSTA	WAGT	26	30	30	NBC
GA	AUGUSTA	WFXG	54	51	51	FOX
GA	BAINBRIDGE	WTLH	49	50	49	FOX
GA	BAXLEY	WGSA	34	35	35	CW
GA	BRUNSWICK	WPXC	21	24	24	ION
GA	CHATSWORTH	WNGH-TV	18	33	33	PBS
GA	COCHRAN	WMUM	29	7	7	PBS
GA	COLUMBUS	WRBL	3	15	15	CBS
GA	COLUMBUS	WTVM	9	47	9	ABC
GA	COLUMBUS	WJSP-TV	28	23	23	PBS
GA	COLUMBUS	WLTZ	38	35	35	NBC
GA	COLUMBUS	WXTX	54	49	49	FOX
GA	CORDELE	WSST-TV	55	51	51	IND
GA	DALTON	WELF-TV	23	16	16	REL
GA	DAWSON	WACS-TV	25	8	8	PBS
GA	MACON	WMAZ-TV	13	4	13	CBS
GA	MACON	WGXA	24	16	16	FOX
GA	MACON	WMGT-TV	41	40	40	NBC

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
GA	MACON	WGNM	64	45	45	REL
GA	MONROE	WHSG	63	44	44	IND
GA	PELHAM	WABW-TV	14	6	6	PBS
GA	PERRY	WPGA	58	32	32	ABC
GA	ROME	WPXA	14	51	51	ION
GA	SAVANNAH	WSAV-TV	3	39	39	NBC
GA	SAVANNAH	WVAN-TV	9	9	9	PBS
GA	SAVANNAH	WTOC-TV	11	15	11	CBS
GA	SAVANNAH	WJCL	22	23	22	ABC
GA	THOMASVILLE	WCTV	6	46	46	CBS
GA	TOCCOA	WNEG-TV	32	24	24	CBS
GA	VALDOSTA	WSWG	44	43	43	CBS
GA	WAYCROSS	WXGA-TV	8	8	8	PBS
GA	WRENS	WCES-TV	20	6	6	PBS
GU	**AGANA**	**KUAM-TV**	**8**	**8**	**8**	**NBC**
GU	AGANA	KGTF	12	12	12	ED
GU	TAMUNING	KTGM	14	14	14	ABC
HI	**HILO**	**KHBC-TV**	**2**	**22**	**22**	**NBC**
HI	HILO	KGMB	9	22	9	CBS
HI	HILO	KHAW	11	21	11	FOX
HI	HILO	KHVO	13	18	13	ABC
HI	HILO	KWHH	14	23	23	IND
HI	HONOLULU	KHON-TV	2	8	8	FOX
HI	HONOLULU	KITV	4	40	40	ABC
HI	HONOLULU	KFVE	5	23	23	My TV
HI	HONOLULU	KGMB	9	8	9	CBS
HI	HONOLULU	KHET	11	18	11	PBS
HI	HONOLULU	KHNL	13	35	35	NBC
HI	HONOLULU	KWHE	14	31	31	IND
HI	HONOLULU	KIKU-TV	20	19	19	IND
HI	HONOLULU	KAAH	26	27	27	IND
HI	HONOLULU	KBFD	32	33	33	IND
HI	HONOLULU	KALO	38	10	10	REL
HI	HONOLULU	KWBN	44	43	43	ED
HI	KAILUA	KKAI	50	50	50	IND
HI	KAILUA KONA	KLEI	6	25	25	IND
HI	KANEOHE	KPXO	66	41	41	ION

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
HI	WAILUKU	KGMV	3	24	24	CBS
HI	WAILUKU	KAII-TV	7	36	7	FOX
HI	WAILUKU	KMEB	10	30	10	PBS
HI	WAILUKU	KMAU	12	29	12	ABC
HI	WAILUKU	KOGG	15	16	16	NBC
HI	WAILUKU	KWHM	21	45	21	IND
HI	WAIMANALO	KUPU	56	38	38	REL
IA	**AMES**	**WOI -TV**	**5**	**59**	**5**	**ABC**
IA	AMES	KCWI-TV	23	23	23	CW
IA	AMES	KEFB	34	34	34	REL
IA	BURLINGTON	KGCW-TV	26	41	41	CW
IA	CEDAR RAP.	KGAN	2	51	51	CBS
IA	CEDAR RAP.	KCRG-TV	9	52	9	ABC
IA	CEDAR RAP.	KFXA	28	27	27	FOX
IA	CEDAR RAP.	KPXR	48	47	47	ION
IA	COUNCIL BL.	KBIN	32	33	33	PBS
IA	DAVENPORT	KWQC-TV	6	56	36	NBC
IA	DAVENPORT	KLJB-TV	18	49	49	FOX
IA	DAVENPORT	KQIN	36	34	34	PBS
IA	DES MOINES	KCCI-TV	8	31	8	CBS
IA	DES MOINES	KDIN-TV	11	50	11	PBS
IA	DES MOINES	WHO -TV	13	19	13	NBC
IA	DES MOINES	KDSM-TV	17	16	16	FOX
IA	DES MOINES	KDMI		31	31	My TV
IA	DUBUQUE	KFXB	40	43	43	REL
IA	FORT DODGE	KTIN	21	25	25	PBS
IA	IOWA CITY	KIIN-TV	12	45	12	PBS
IA	IOWA CITY	KWKB	20	25	25	CW
IA	MASON CITY	KIMT	3	42	42	CBS
IA	MASON CITY	KYIN	24	18	18	PBS
IA	NEWTON	KFPX	39	39	39	ION
IA	OTTUMWA	KYOU-TV	15	14	15	FOX
IA	RED OAK	KHIN	36	35	35	PBS
IA	SIOUX CITY	KTIV	4	41	41	NBC
IA	SIOUX CITY	KCAU-TV	9	30	9	ABC
IA	SIOUX CITY	KMEG	14	39	39	CBS
IA	SIOUX CITY	KSIN	27	28	28	PBS

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
IA	SIOUX CITY	KPTH	44	49	44	FOX
IA	WATERLOO	KWWL	7	55	7	NBC
IA	WATERLOO	KWWF	22	22	22	IND
IA	WATERLOO	KRIN	32	35	35	PBS
ID	**BOISE**	**KBCI-TV**	**2**	**28**	**28**	**CBS**
ID	BOISE	KAID	4	21	21	PBS
ID	BOISE	KTVB	7	26	7	NBC
ID	BOISE	KKJB	39	39	39	IND
ID	CALDWELL	KNIN-TV	9	10	10	CW
ID	COEUR D'ALENE	KCDT	26	45	45	PBS
ID	FILER	KBGH	19	18	18	ED
ID	IDAHO FALLS	KIDK	3	36	36	CBS
ID	IDAHO FALLS	KIFI-TV	8	9	8	ABC
ID	IDAHO FALLS	CP	20	20	20	
ID	LEWISTON	KLEW-TV	3	32	32	CBS
ID	MOSCOW	KUID-TV	12	12	12	PBS
ID	NAMPA	KIVI	6	24	24	ABC
ID	NAMPA	KTRV-TV	12	13	13	FOX
ID	POCATELLO	KPVI	6	23	23	NBC
ID	POCATELLO	KISU-TV	10	17	17	PBS
ID	POCATELLO	KPIF	15	15	15	CW
ID	POCATELLO	KFXP	31	31	31	FOX
ID	SUN VALLEY	KIDA	5	32	5	IND
ID	TWIN FALLS	KMVT	11	16	11	CBS
ID	TWIN FALLS	KIPT	13	22	22	PBS
ID	TWIN FALLS	KXTF	35	34	34	FOX
IL	**AURORA**	**WXFT**	**60**	**59**	**50**	**TLF**
IL	BLOOMINGTON	WYZZ-TV	43	28	28	FOX
IL	CARBONDALE	WSIU-TV	8	40	8	PBS
IL	CHAMPAIGN	WCIA	3	48	48	CBS
IL	CHAMPAIGN	WICD	15	41	41	ABC
IL	CHARLESTON	WEIU-TV	51	50	50	PBS
IL	CHICAGO	WBBM-TV	2	3	12	CBS
IL	CHICAGO	WMAQ-TV	5	29	29	NBC
IL	CHICAGO	WLS -TV	7	52	7	ABC
IL	CHICAGO	WGN -TV	9	19	19	CW
IL	CHICAGO	WTTW	11	47	47	PBS

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
IL	CHICAGO	WYCC	20	21	21	PBS
IL	CHICAGO	WCIU-TV	26	27	27	IND
IL	CHICAGO	WFLD	32	31	31	FOX
IL	CHICAGO	WCPX	38	43	43	ION
IL	CHICAGO	WSNS-TV	44	45	45	TLM
IL	DECATUR	WAND-TV	17	18	18	NBC
IL	DECATUR	WBUI	23	22	22	CW
IL	E. ST. LOUIS	WRBU	46	47	47	My TV
IL	FREEPORT	WIFR-TV	23	41	23	CBS
IL	GALESBURG	CP		8	8	
IL	HARRISBURG	WSIL-TV	3	34	34	ABC
IL	JACKSONVILLE	WSEC	14	15	15	PBS
IL	JOLIET	WGBO-TV	66	53	38	UNV
IL	LASALLE	WWTO-TV	35	10	10	REL
IL	MACOMB	WMEC	22	21	21	PBS
IL	MARION	WTCT	27	17	17	IND
IL	MOLINE	WQAD-TV	8	38	38	ABC
IL	MOLINE	WQPT-TV	24	23	23	PBS
IL	MT. VERNON	WPXS	13	21	21	IND
IL	OLNEY	KUSI-TV	16	19	19	ED
IL	OLNEY	WUSI-TV	16	19	19	PBS
IL	PEORIA	WHOI	19	40	19	ABC
IL	PEORIA	WEEK-TV	25	57	25	NBC
IL	PEORIA	WMBD-TV	31	30	30	CBS
IL	PEORIA	WTVP	47	46	46	PBS
IL	PEORIA	WAOE	59	39	39	My TV
IL	QUINCY	WGEM-TV	10	54	10	NBC
IL	QUINCY	WTJR	16	32	32	IND
IL	QUINCY	WQEC	27	34	34	PBS
IL	ROCK ISLAND	KHBF-TV	4	58	4	IND
IL	ROCK ISLAND	WHBF-TV	4	58	4	CBS
IL	ROCKFORD	WREX-TV	13	54	13	NBC
IL	ROCKFORD	WTVO	17	16	16	ABC
IL	ROCKFORD	WQRF-TV	39	42	42	FOX
IL	SPRINGFIELD	WICS	20	42	42	ABC
IL	SPRINGFIELD	WCFN	49	53	13	My TV
IL	SPRINGFIELD	WRSP-TV	55	44	44	FOX

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
IL	URBANA	WILL-TV	12	9	9	PBS
IL	URBANA	WCCU	27	26	26	FOX
IN	**ANGOLA**	**WINM**	**63**	**12**	**12**	**IND**
IN	BLOOMINGTON	WTTV	4	48	48	CW
IN	BLOOMINGTON	WTIU	30	14	14	PBS
IN	BLOOMINGTON	WCLJ	42	56	42	IND
IN	BLOOMINGTON	WIPX	63	27	27	ION
IN	ELKHART	WSJV	28	58	28	FOX
IN	EVANSVILLE	WTVW	7	28	28	FOX
IN	EVANSVILLE	WNIN	9	12	9	PBS
IN	EVANSVILLE	WFIE-TV	14	46	46	NBC
IN	EVANSVILLE	WEHT-TV	25	59	7	ABC
IN	EVANSVILLE	WEVV	44	45	45	CBS
IN	FORT WAYNE	WANE-TV	15	31	31	CBS
IN	FORT WAYNE	WPTA	21	24	24	ABC
IN	FORT WAYNE	WISE-TV	33	19	19	NBC
IN	FORT WAYNE	WFWA	39	40	40	PBS
IN	FORT WAYNE	WFFT-TV	55	36	36	FOX
IN	GARY	WPWR-TV	50	51	51	My TV
IN	GARY	WYIN	56	17	17	PBS
IN	HAMMOND	WJYS	62	36	36	IND
IN	INDIANAPOLIS	WRTV	6	25	25	ABC
IN	INDIANAPOLIS	WISH-TV	8	9	9	CBS
IN	INDIANAPOLIS	WTHR	13	46	13	NBC
IN	INDIANAPOLIS	WFYI	20	21	21	PBS
IN	INDIANAPOLIS	WHMB-TV	40	16	16	IND
IN	INDIANAPOLIS	WXIN	59	45	45	FOX
IN	INDIANAPOLIS	WDTI-TV	69	44	44	IND
IN	KOKOMO	WTTK	29	54	29	CW
IN	LAFAYETTE	WLFI-TV	18	11	11	CBS
IN	MARION	WNDY	23	32	32	My TV
IN	MUNCIE	WIPB	49	52	23	PBS
IN	RICHMOND	WKOI	43	39	39	IND
IN	SALEM	WMYO	58	51	51	My TV
IN	SOUTH BEND	WNDU-TV	16	42	42	NBC
IN	SOUTH BEND	WSBT-TV	22	30	22	CBS
IN	SOUTH BEND	WNIT-TV	34	35	35	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
IN	SOUTH BEND	WHME-TV	46	48	48	IND
IN	TERRE HAUTE	WTWO	2	36	36	NBC
IN	TERRE HAUTE	WTHI-TV	10	24	10	CBS
IN	TERRE HAUTE	WFXW	38	39	39	FOX
IN	VINCENNES	WVUT	22	52	22	PBS
KS	**COLBY**	**KLBY**	**4**	**17**	**17**	**ABC**
KS	COLBY	KWKS		19	19	PBS
KS	DERBY	KDCU		46	46	UNV
KS	DODGE CITY	KDCK	21	21	21	PBS
KS	ENSIGN	KBSD-TV	6	6	6	CBS
KS	GARDEN CITY	KSNG-TV	11	16	11	NBC
KS	GARDEN CITY	KUPK-TV	13	18	13	ABC
KS	GOODLAND	KBSL-TV	10	10	10	CBS
KS	GREAT BEND	KSNC	2	22	22	NBC
KS	HAYS	KOOD	9	16	16	PBS
KS	HOISINGTON	KOCW	14	14	14	FOX
KS	HUTCHINSON	KPTS	8	29	8	PBS
KS	HUTCHINSON	KWCH-TV	12	19	12	CBS
KS	HUTCHINSON	KMTW	36	35	35	My TV
KS	LAKIN	KSNW	3	45	8	NBC
KS	LAKIN	KSWK	3	8	8	PBS
KS	LAWRENCE	KMCI	38	36	41	IND
KS	PITTSBURG	KOAM-TV	7	13	7	CBS
KS	PITTSBURG	KFJX	14	13	13	FOX
KS	SALINA	KAAS-TV	18	17	17	FOX
KS	TOPEKA	KTWU	11	23	11	PBS
KS	TOPEKA	KIBW-TV	13	44	13	CBS
KS	TOPEKA	KSQA	22	12	12	CP
KS	TOPEKA	KSNT	27	28	27	NBC
KS	TOPEKA	KTKA-TV	49	48	49	ABC
KS	WICHITA	KSNW	3	45	45	NBC
KS	WICHITA	KAKE-TV	10	21	10	ABC
KS	WICHITA	KSAS-TV	24	26	26	FOX
KS	WICHITA	KSCW	33	31	19	CW
KY	**ASHLAND**	**WKAS**	**25**	**26**	**26**	**PBS**
KY	ASHLAND	WTSF	61	44	44	IND
KY	BEATTYVILLE	WLJC-TV	65	7	7	IND

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
KY	BOWL. GREEN	WBKO	13	33	13	ABC
KY	BOWL. GREEN	WKYU-TV	24	18	18	PBS
KY	BOWL. GREEN	WNKY	40	16	16	NBC
KY	BOWL. GREEN	WKGB-TV	53	48	48	PBS
KY	CAMPBELLSVILLE	WBKI	34	19	19	CW
KY	COVINGTON	WCVN	54	24	24	PBS
KY	DANVILLE	WDKY-TV	56	4	4	FOX
KY	ELIZABETHTOWN	WKZT-TV	23	43	43	PBS
KY	HARLAN	WAGV	44	51	51	IND
KY	HAZARD	WKHA	35	16	16	PBS
KY	HAZARD	WYMT-TV	57	12	12	CBS
KY	LEXINGTON	WLEX-TV	18	39	39	NBC
KY	LEXINGTON	WKYT-TV	27	13	13	CW
KY	LEXINGTON	WTVQ-TV	36	40	40	ABC
KY	LEXINGTON	WKLE	46	42	42	PBS
KY	LOUISVILLE	WAVE	3	47	47	NBC
KY	LOUISVILLE	WHAS-TV	11	55	11	ABC
KY	LOUISVILLE	WKPC-TV	15	17	17	PBS
KY	LOUISVILLE	WBNA	21	8	8	ION
KY	LOUISVILLE	WLKY	32	26	26	CBS
KY	LOUISVILLE	WDRB	41	49	49	FOX
KY	LOUISVILLE	WKMJ	68	38	38	PBS
KY	MADISONVILLE	WAZE-TV	19	20	20	CW
KY	MADISONVILLE	WKMA	35	42	42	PBS
KY	MOREHEAD	WKMR	38	15	15	PBS
KY	MOREHEAD	WUPX	67	21	21	ION
KY	MURRAY	WKMU	21	36	36	PBS
KY	NEWPORT	WXIX-TV	19	29	29	FOX
KY	OWENSBORO	WKOH	31	30	30	PBS
KY	OWENTON	WKON	52	44	44	PBS
KY	PADUCAH	WPSD-TV	6	32	32	NBC
KY	PADUCAH	WKPD	29	41	41	PBS
KY	PADUCAH	WDKA	49	50	49	My TV
KY	PIKEVILLE	WKPI	22	24	24	PBS
KY	SOMERSET	WKSO-TV	29	14	14	PBS
LA	**ALEXANDRIA**	**KALB-TV**	**5**	**35**	**35**	**NBC**
LA	ALEXANDRIA	KLPA-TV	25	26	26	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
LA	ALEXANDRIA	KLAX-TV	31	32	31	ABC
LA	ALEXANDRIA	KBCA	41	41	41	CW
LA	BAT. ROUGE	WBRZ	2	13	13	ABC
LA	BAT. ROUGE	WAFB	9	46	9	CBS
LA	BAT. ROUGE	WLPB-TV	27	25	25	PBS
LA	BAT. ROUGE	WVLA	33	34	34	NBC
LA	BAT. ROUGE	WGMB-TV	44	45	45	FOX
LA	COLUMBIA	KAQY	11	57	11	ABC
LA	HAMMOND	KGLA-DT			42	TLM
LA	LAFAYETTE	KATC	3	28	28	ABC
LA	LAFAYETTE	KLFY-TV	10	56	10	CBS
LA	LAFAYETTE	KADN	15	16	16	FOX
LA	LAFAYETTE	KLPB-TV	24	23	23	PBS
LA	LK. CHARLES	KPLC-TV	7	8	7	NBC
LA	LK. CHARLES	KLTL-TV	18	20	20	PBS
LA	LK. CHARLES	KVHP	29	30	30	FOX
LA	MINDEN	KPXJ	21	21	21	CW
LA	MONROE	WVUE	8	29	8	FOX
LA	MONROE	KNOE-TV	8	7	8	CBS
LA	MONROE	KLTM	13	19	13	PBS
LA	NEW IBERIA	KLWB	50	50	50	CW
LA	NEW ORLEANS	WWL -TV	4	36	36	CBS
LA	NEW ORLEANS	WDSU-TV	6	43	43	NBC
LA	NEW ORLEANS	WVUE	8	29	8	FOX
LA	NEW ORLEANS	WYES-TV	12	11	11	PBS
LA	NEW ORLEANS	WHNO-TV	20	21	21	IND
LA	NEW ORLEANS	WGNO	26	15	26	ABC
LA	NEW ORLEANS	WLAE-TV	32	31	31	PBS
LA	NEW ORLEANS	WNOL-TV	38	40	15	CW
LA	NEW ORLEANS	WPXL	49	50	50	ION
LA	SHREVEPORT	KTBS-TV	3	28	28	ABC
LA	SHREVEPORT	KSLA-TV	12	17	17	CBS
LA	SHREVEPORT	KLTS-TV	24	25	25	PBS
LA	SHREVEPORT	KMSS-TV	33	34	34	FOX
LA	SHREVEPORT	KSHV	45	44	44	My TV
LA	SLIDELL	WUPL	54	24	24	My TV
LA	W. MONROE	KARD	14	36	36	FOX

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
LA	W. MONROE	KMCT-TV	39	38	38	REL
MA	**ADAMS**	**WCDC-TV**	**19**	**36**	**36**	**ABC**
MA	BOSTON	WGBH-TV	2	19	19	PBS
MA	BOSTON	WBZ -TV	4	30	30	CBS
MA	BOSTON	WCVB-TV	5	20	20	ABC
MA	BOSTON	WHDH	7	42	7	NBC
MA	BOSTON	WFXT	25	31	31	FOX
MA	BOSTON	WSBK-TV	38	39	39	IND
MA	BOSTON	WGBX-TV	44	43	43	PBS
MA	BOSTON	WBPX-TV	68	32	32	ION
MA	CAMBRIDGE	WLVI-TV	56	41	41	CW
MA	LAWRENCE	WMFP	62	18	18	IND
MA	MARLBOROUGH	WUTF	66	23	27	TLF
MA	NEW BEDFORD	WLNE	6	49	49	ABC
MA	NEW BEDFORD	WLWC	28	22	22	CW
MA	NORWELL	WWDP	46	52	10	IND
MA	PITTSFIELD	WNYA	51	13	13	My TV
MA	SPRINGFIELD	WWLP	22	11	11	NBC
MA	SPRINGFIELD	WGGB-TV	40	55	40	ABC
MA	SPRINGFIELD	WGBY-TV	57	58	22	PBS
MA	VNYD. HAVEN	WDPX	58	40	40	ION
MA	WORCESTER	WUNI	27	29	29	UNV
MA	WORCESTER	WYDN	48	47	47	PBS
MD	**ANNAPOLIS**	**WMPT**	**22**	**42**	**42**	**PBS**
MD	BALTIMORE	WMAR-TV	2	52	38	ABC
MD	BALTIMORE	WBAL-TV	11	59	11	NBC
MD	BALTIMORE	WJZ-TV	13	38	13	CBS
MD	BALTIMORE	WUTB	24	41	41	My TV
MD	BALTIMORE	WBFF	45	46	46	FOX
MD	BALTIMORE	WNUV-TV	54	40	40	CW
MD	BALTIMORE	WMPB	67	29	29	PBS
MD	FREDERICK	WFPT	62	28	28	PBS
MD	HAGERSTOWN	WHAG-TV	25	55	26	NBC
MD	HAGERSTOWN	WWPB	31	44	44	PBS
MD	HAGERSTOWN	WJAL	68	16	39	IND
MD	OAKLAND	WGPT	36	54	36	PBS
MD	SALISBURY	WBOC-TV	16	21	21	CBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MD	SALISBURY	WCPB	28	56	28	PBS
MD	SALISBURY	WMDT	47	53	47	ABC
ME	**AUGUSTA**	**WCBB**	**10**	**17**	**10**	**PBS**
ME	BANGOR	WLBZ	2	25	2	NBC
ME	BANGOR	WABI-TV	5	19	19	CBS
ME	BANGOR	WVII-TV	7	14	7	ABC
ME	BIDDEFORD	WMEA-TV	26	45	45	PBS
ME	CALAIS	WMED-TV	13	10	10	PBS
ME	LEWISTON	WPME	35	28	35	My TV
ME	ORONO	WMEB-TV	12	9	9	PBS
ME	POLAND SPR.	WMTW	8	46	8	ABC
ME	PORTLAND	WCSH	6	44	44	NBC
ME	PORTLAND	WGME-TV	13	38	38	CBS
ME	PORTLAND	WPXT	51	43	43	CW
ME	PRESQUE ISLE	WAGM-TV	8	16	8	CBS
ME	PRESQUE ISLE	WMEM-TV	10	20	10	PBS
ME	PRESQUE ISLE	CP	47	47	47	
ME	WATERVILLE	WPFO	23	23	23	FOX
MI	**ALPENA**	**WCML-TV**	**6**	**57**	**24**	**PBS**
MI	ALPENA	WBKB-TV	11	13	11	CBS
MI	ANN ARBOR	WPXD	31	33	31	ION
MI	BAD AXE	WDCQ-TV	35	15	15	PBS
MI	BATTLE CRK.	WOTV	41	20	20	ABC
MI	BATTLE CRK.	WZPX	43	44	44	ION
MI	BAY CITY	WNEM-TV	5	22	22	CBS
MI	BAY CITY	WBSF	46	46	46	CW
MI	CADILLAC	WWTV	9	40	9	CBS
MI	CADILLAC	WCMV	27	17	17	PBS
MI	CADILLAC	WFQX	33	47	47	FOX
MI	CALUMET	WBKP	5	5	5	CW
MI	CHEBOYGAN	WTOM-TV	4	35	35	NBC
MI	DETROIT	WJBK	2	58	7	FOX
MI	DETROIT	WDIV	4	45	45	NBC
MI	DETROIT	WXYZ-TV	7	41	41	ABC
MI	DETROIT	WMYD	20	21	21	My TV
MI	DETROIT	WKBD-TV	50	14	14	CW
MI	DETROIT	WTVS	56	56	43	PBS

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MI	DETROIT	WWJ-TV	62	44	44	CBS
MI	EAST LANSING	WKAR-TV	23	55	40	PBS
MI	ESCANABA	WJMN-TV	3	48	48	CBS
MI	FLINT	WJRT-TV	12	36	12	ABC
MI	FLINT	WFUM	28	52	28	PBS
MI	FLINT	WSMH	66	16	16	FOX
MI	GRAND RAPIDS	WOOD-TV	8	7	7	NBC
MI	GRAND RAPIDS	WZZM-TV	13	39	13	ABC
MI	GRAND RAPIDS	WXMI	17	19	19	FOX
MI	GRAND RAPIDS	WGVU	35	11	11	PBS
MI	IRON MOUNT.	WDHS	8	22	8	IND
MI	ISHPEMING	WBUP	10	10	10	ABC
MI	JACKSON	WHTV-TV	18	34	34	My TV
MI	KALAMAZOO	WWMT	3	2	8	CW
MI	KALAMAZOO	WGVK	52	5	5	PBS
MI	KALAMAZOO	WLLA	64	45	45	IND
MI	LANSING	WLNS-TV	6	59	36	CBS
MI	LANSING	WSYM-TV	47	38	38	FOX
MI	LANSING	WLAJ	53	51	51	ABC
MI	MANISTEE	WCMW	21	58	21	PBS
MI	MARQUETTE	WLUC-TV	6	35	35	NBC
MI	MARQUETTE	WNMU-TV	13	33	13	PBS
MI	MARQUETTE	WMQF	19	19	19	My TV
MI	MT. CLEMENS	WADL	38	39	39	IND
MI	MT. PLEASANT	WCMU-TV	14	56	26	PBS
MI	MUSKEGON	WTLJ	54	24	24	IND
MI	ONONDAGA	WILX-TV	10	57	10	NBC
MI	SAGINAW	WEYI-TV	25	30	30	NBC
MI	SAGINAW	WAQP	49	48	48	IND
MI	SAULT STE. MARIE	WGTQ	8	9	8	ABC
MI	SAULT STE. MARIE	WWUP-TV	10	49	10	CBS
MI	TRAVERSE CITY	WPBN-TV	7	50	7	NBC
MI	TRAVERSE CITY	WGTU	29	31	29	ABC
MI	VANDERBILT	WFUP	45	45	45	FOX
MN	**ALEXANDRIA**	**KCCO-TV**	**7**	**24**	**7**	**CBS**

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MN	ALEXANDRIA	KSAX	42	36	42	ABC
MN	APPLETON	KWCM-TV	10	31	10	PBS
MN	AUSTIN	KAAL	6	33	36	ABC
MN	AUSTIN	KSMQ-TV	15	20	20	PBS
MN	BEMIDJI	KAWE	9	18	9	PBS
MN	BEMIDJI	KFTC	26	26	26	FOX
MN	BRAINERD	KAWB	22	28	28	PBS
MN	CHISHOLM	KRII	11	11	11	NBC
MN	CROOKSTON	KCGE-DT		16	16	PBS
MN	DULUTH	KDLH	3	33	33	CBS
MN	DULUTH	WDSE-TV	8	38	8	PBS
MN	DULUTH	WDIO-TV	10	43	10	ABC
MN	DULUTH	KQDS-TV	21	17	17	FOX
MN	DULUTH	KCWV	27	27	27	CP
MN	HIBBING	WIRT	13	36	13	ABC
MN	HIBBING	WRPT		31	31	CP
MN	MANKATO	KEYC-TV	12	38	12	CBS
MN	MINNEAPOLIS	WCCO-TV	4	32	32	CBS
MN	MINNEAPOLIS	KMSP-TV	9	26	9	FOX
MN	MINNEAPOLIS	KARE	11	35	11	NBC
MN	MINNEAPOLIS	WUCW	23	22	22	CW
MN	MINNEAPOLIS	WFTC	29	21	29	My TV
MN	MINNEAPOLIS	KSTC-TV	45	44	45	IND
MN	REDWOOD FALLS	KRWF	43	27	27	ABC
MN	ROCHESTER	KTTC	10	36	10	NBC
MN	ROCHESTER	KXLT-TV	47	46	46	FOX
MN	ST. CLOUD	KPXM	41	40	40	ION
MN	ST. PAUL	KTCA-TV	2	34	34	PBS
MN	ST. PAUL	KSTP-TV	5	50	35	ABC
MN	ST. PAUL	KTCI-TV	17	16	26	PBS
MN	THIEF RIV FALLS	KBRR	10	10	10	FOX
MN	WALKER	KCCW-TV	12	20	12	CBS
MN	WORTHINGTON	KSMN	20	15	15	PBS
MO	**CAPE GIRARDEAU**	**KFVS-TV**	**12**	**57**	**12**	**CBS**
MO	CAPE GIRARDEAU	KBSI	23	22	22	FOX
MO	COLUMBIA	KOMU-TV	8	36	8	NBC
MO	COLUMBIA	KMIZ	17	22	17	ABC

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MO	HANNIBAL	KHQA-TV	7	29	7	CBS
MO	JEFFERSON CITY	KRCG	13	12	12	CBS
MO	JEFFERSON CITY	KNLJ	25	20	20	IND
MO	JOPLIN	KODE	12	43	43	ABC
MO	JOPLIN	KSNF	16	46	46	NBC
MO	JOPLIN	KOZJ	26	25	25	PBS
MO	KANSAS CITY	WDAF-TV	4	34	34	FOX
MO	KANSAS CITY	KCTV	5	24	24	CBS
MO	KANSAS CITY	KMBC-TV	9	7	9	ABC
MO	KANSAS CITY	KCPT	19	18	18	PBS
MO	KANSAS CITY	KCWE	29	31	31	CW
MO	KANSAS CITY	KSHB-TV	41	42	42	NBC
MO	KANSAS CITY	KPXE	50	51	51	ION
MO	KANSAS CITY	KSMO-TV	62	47	47	My TV
MO	KIRKSVILLE	KTVO	3	33	33	ABC
MO	OSAGE BEACH	KRBK	49	49	49	CP
MO	POPLAR BLUFF	KPOB-TV	15	15	15	
MO	SEDALIA	KMOS-TV	6	15	15	PBS
MO	SPRINGFIELD	KYTV	3	44	44	NBC
MO	SPRINGFIELD	KOLR	10	52	10	CBS
MO	SPRINGFIELD	KOZK	21	23	23	PBS
MO	SPRINGFIELD	KSFX	27	28	28	FOX
MO	SPRINGFIELD	KSPR	33	19	19	ABC
MO	ST. JOSEPH	KQTV	2	53	7	ABC
MO	ST. JOSEPH	KTAJ	16	21	21	REL
MO	ST. LOUIS	KTVI-TV	2	43	43	FOX
MO	ST. LOUIS	KMOV	4	56	24	CBS
MO	ST. LOUIS	KSDK	5	35	35	NBC
MO	ST. LOUIS	KETC	9	39	39	PBS
MO	ST. LOUIS	KPLR-TV	11	26	26	CW
MO	ST. LOUIS	KNLC	24	14	14	IND
MO	ST. LOUIS	KDNL-TV	30	31	31	ABC
MS	**BILOXI**	**WLOX**	**13**	**39**	**13**	**ABC**
MS	BILOXI	WMAH-TV	19	16	16	PBS
MS	BOONEVILLE	WMAE-TV	12	55	12	PBS
MS	BUDE	WMAU-TV	17	18	18	PBS
MS	COLUMBUS	WCBI-TV	4	35	35	CBS

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MS	COLUMBUS	WMAA		43	43	ED
MS	GREENVILLE	WXVT	15	17	15	CBS
MS	GREENWOOD	WABG-TV	6	32	32	ABC
MS	GREENWOOD	WMAO-TV	23	25	25	PBS
MS	GULFPORT	WXXV-TV	25	48	48	FOX
MS	HATTIESBURG	WHLT	22	58	22	CBS
MS	HOLLY SPRINGS	WBUY	40	41	41	IND
MS	HOUSTON	WKDH	45	45	45	ABC
MS	JACKSON	WLBT-TV	3	9	7	NBC
MS	JACKSON	WJTV	12	52	12	CBS
MS	JACKSON	WAPT	16	21	21	ABC
MS	JACKSON	WMPN-TV	29	20	20	PBS
MS	JACKSON	WDBD	40	41	40	FOX
MS	JACKSON	WWJX	51	51	51	CP
MS	LAUREL	WDAM-TV	7	28	28	NBC
MS	MAGEE	WRBJ	34	34	34	CW
MS	MERIDIAN	WTOK-TV	11	49	11	ABC
MS	MERIDIAN	WMAW-TV	14	44	44	PBS
MS	MERIDIAN	WMDN	24	26	24	CBS
MS	MERIDIAN	WGBC	30	31	31	NBC
MS	MS STATE	WMAB-TV	2	10	10	PBS
MS	NATCHEZ	WNTZ-TV	48	49	49	FOX
MS	OXFORD	WMAV-TV	18	36	36	PBS
MS	TUPELO	WTVA	9	8	8	NBC
MS	VICKSBURG	WUFX	35	41	41	My TV
MS	WEST POINT	WLOV-TV	27	16	16	FOX
MT	**BILLINGS**	**KTVQ**	**2**	**10**	**10**	**CBS**
MT	BILLINGS	KSVI	6	18	18	ABC
MT	BILLINGS	KULR-TV	8	11	11	NBC
MT	BOZEMAN	KBZK	7	13	13	CBS
MT	BOZEMAN	KUSM	9	8	8	PBS
MT	BUTTE	KXLF-TV	4	5	5	CBS
MT	BUTTE	KTVM	6	33	6	NBC
MT	BUTTE	KWYB	18	19	19	ABC
MT	BUTTE	KBTZ	24	24	24	FOX
MT	GLENDIVE	KXGN-TV	5	10	10	CBS
MT	GREAT FALLS	KRTV	3	7	7	CBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
MT	GREAT FALLS	KFBB-TV	5	8	8	ABC
MT	GREAT FALLS	KTGF	16	45	45	FOX
MT	GREAT FALLS	KLMN	26	26	26	FOX
MT	HARDIN	KHMT-TV	4	22	22	FOX
MT	HAVRE	KBBJ	9	9	9	NBC
MT	HELENA	KMTF	10	29	29	CW
MT	HELENA	KTVH	12	14	12	NBC
MT	KALISPELL	KCFW-TV	9	38	9	NBC
MT	LEWISTOWN	KBAO	13	13	13	NBC
MT	MILES CITY	KYUS-TV	3	3	3	NBC
MT	MISSOULA	KPAX-TV	8	7	7	CBS
MT	MISSOULA	KUFM-TV	11	27	11	PBS
MT	MISSOULA	KECI-TV	13	40	13	NBC
MT	MISSOULA	KMMF	17	17	17	FOX
MT	MISSOULA	KTMF-TV	23	36	23	ABC
NC	**ASHEVILLE**	**WLOS**	**13**	**56**	**13**	**ABC**
NC	ASHEVILLE	WUNF-TV	33	25	25	PBS
NC	ASHEVILLE	WYCW	62	45	45	CW
NC	BELMONT	WJZY	46	47	47	CW
NC	BURLINGTON	WGPX	16	14	14	ION
NC	CHAPEL HILL	WUNC-TV	4	59	25	PBS
NC	CHARLOTTE	WBTV	3	23	23	CBS
NC	CHARLOTTE	WSOC-TV	9	34	34	ABC
NC	CHARLOTTE	WCCB	18	27	27	FOX
NC	CHARLOTTE	WCNC-TV	36	22	22	NBC
NC	CHARLOTTE	WTVI	42	11	11	PBS
NC	CONCORD	WUNG-TV	58	44	44	PBS
NC	DURHAM	WTVD	11	52	11	ABC
NC	DURHAM	WRDC	28	27	28	My TV
NC	EDENTON	WUND-TV	2	20	20	PBS
NC	FAYETTEVILLE	WUVC	40	38	38	UNV
NC	FAYETTEVILLE	WFPX	62	36	36	ION
NC	GOLDSBORO	WUNE-TV	17	54	17	PBS
NC	GREENSBORO	WFMY-TV	2	51	51	CBS
NC	GREENSBORO	WMYV	48	33	33	My TV
NC	GREENSBORO	WLXI-TV	61	43	43	IND
NC	GREENVILLE	WNCT-TV	9	10	10	CBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
NC	GREENVILLE	WYDO	14	21	14	FOX
NC	GREENVILLE	WUNK-TV	25	23	23	PBS
NC	GREENVILLE	WEPX	38	51	51	ION
NC	HICKORY	WHKY-TV	14	40	40	IND
NC	HIGH POINT	WGHP	8	35	8	FOX
NC	JACKSONVILLE	WUNM-TV	19	18	19	PBS
NC	JACKSONVILLE	WPXU	35	34	34	ION
NC	KANNAPOLIS	WAXN	64	50	50	IND
NC	LEXINGTON	WCWG	20	19	19	CW
NC	LINVILLE	WNCN-TV	17	55	17	NBC
NC	LUMBERTON	WUNU	31	25	31	PBS
NC	MANTEO	WSKY-TV	4	4	9	IND
NC	MOREHEAD CITY	WFXI	8	24	8	FOX
NC	NEW BERN	WCTI	12	48	12	ABC
NC	RALEIGH	WRAL-TV	5	53	48	CBS
NC	RALEIGH	WLFL	22	57	27	CW
NC	RALEIGH	WRAZ	50	49	49	FOX
NC	ROANOKE RAP.	WUNP-TV	36	39	36	PBS
NC	ROCKY MT.	WRPX	47	15	15	ION
NC	WASHINGTON	WITN-TV	7	32	32	NBC
NC	WILMINGTON	WWAY	3	46	46	ABC
NC	WILMINGTON	WECT	6	44	44	NBC
NC	WILMINGTON	WSFX	26	30	30	FOX
NC	WILMINGTON	WUNJ-TV	39	29	29	PBS
NC	WILSON	WRAY-TV	30	42	42	IND
NC	WINSTON-SALEM	WXII	12	31	31	NBC
NC	WINSTON-SALEM	WUNL-TV	26	32	32	PBS
NC	WINSTON-SALEM	WXLV-TV	45	29	29	ABC
ND	**BISMARCK**	**KBME-TV**	**3**	**22**	**22**	**PBS**
ND	BISMARCK	KFYR-TV	5	31	31	NBC
ND	BISMARCK	KXMB-TV	12	23	12	CBS
ND	BISMARCK	KBMY	17	16	16	ABC
ND	BISMARCK	KNDX	26	26	26	FOX
ND	DEVILS LAKE	WDAZ-TV	8	59	8	ABC
ND	DEVILS LAKE	KMDE		25	25	PBS
ND	DICKINSON	KXMA-TV	2	19	19	CBS
ND	DICKINSON	KQCD-TV	7	7	7	NBC

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
ND	DICKINSON	KDSE	9	20	9	PBS
ND	ELLENDALE	KJRE	19	20	20	PBS
ND	FARGO	WDAY-TV	6	21	21	ABC
ND	FARGO	KXMD-TV	11	14	44	CBS
ND	FARGO	KXMC-TV	13	45	13	CBS
ND	FARGO	KVRR	15	19	19	FOX
ND	GRAND FORKS	KGFE	2	15	15	PBS
ND	GRAND FORKS	KCPM	27	27	27	Not on Air
ND	JAMESTOWN	KJRR	7	7	7	FOX
ND	MINOT	KSRE	6	40	40	PBS
ND	MINOT	KMOT	10	10	10	NBC
ND	MINOT	KFME	13	23	13	PBS
ND	MINOT	KMCY	14	14	14	ABC
ND	MINOT	KXND	24	24	24	FOX
ND	PEMBINA	KNRR	12	15	12	FOX
ND	VALLEY CITY	KXJB-TV	4	38	38	CBS
ND	WILLISTON	KWSE	4	51	51	PBS
ND	WILLISTON	KUMV-TV	8	8	8	NBC
ND	WILLISTON	KVLY-TV	11	44	14	NBC
NE	**ALLIANCE**	**KTNE-TV**	**13**	**24**	**13**	**PBS**
NE	BASSETT	KMNE-TV	7	15	7	PBS
NE	GRAND ISLAND	KGIN	11	32	11	CBS
NE	GRAND ISLAND	KTVG	17	19	19	FOX
NE	HASTINGS	KHAS-TV	5	21	5	NBC
NE	HASTINGS	KHNE-TV	29	28	28	PBS
NE	HAYES CTR.	KWNB-TV	6	18	18	ABC
NE	KEARNEY	KHGI-TV	13	36	36	ABC
NE	LEXINGTON	KLNE-TV	3	26	26	PBS
NE	LINCOLN	KLKN	8	31	8	ABC
NE	LINCOLN	KOLN	10	25	10	CBS
NE	LINCOLN	KUON-TV	12	40	12	PBS
NE	LINCOLN	KCWL-TV	51	51	51	CW
NE	MCCOOK	KSNK	8	12	12	NBC
NE	MERRIMAN	KRNE-TV	12	17	12	PBS
NE	NORFOLK	KXNE-TV	19	16	19	PBS
NE	NORTH PLATTE	KNOP-TV	2	22	2	NBC
NE	NORTH PLATTE	KPNE-TV	9	16	9	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
NE	OMAHA	KMTV	3	45	45	CBS
NE	OMAHA	WOWT	6	22	22	NBC
NE	OMAHA	KETV	7	20	20	ABC
NE	OMAHA	KXVO	15	38	15	CW
NE	OMAHA	KYNE-TV	26	17	17	PBS
NE	OMAHA	KPTM	42	43	43	FOX
NE	SCOTTSBLUFF	KDUH-TV	4	7	7	ABC
NE	SCOTTSBLUFF	KSTF-TV	10	29	29	CBS
NE	SCOTTSBLUFF	KTUW	16	16	17	IND
NE	SUPERIOR	KSNB-TV	4	34	34	FOX
NH	**CONCORD**	**WPXG**	**21**	**33**	**33**	**ION**
NH	DERRY	WZMY-TV	50	35	35	My TV
NH	DURHAM	WENH	11	57	11	PBS
NH	KEENE	WEKW-TV	52	49	49	PBS
NH	LITTLETON	WLED-TV	49	48	48	PBS
NH	MANCHESTER	WMUR-TV	9	59	9	ABC
NH	MERRIMACK	WNEU	60	34	34	TLM
NJ	**ATL. CITY**	**WWSI-TV**	**62**	**49**	**49**	**TLM**
NJ	ATL. CITY	WMCN-TV		44	44	IND
NJ	BURLINGTON	WGTW-TV	48	27	27	REL
NJ	CAMDEN	WNJS	23	22	22	PBS
NJ	LINDEN	WNJU	47	36	36	TLM
NJ	MONTCLAIR	WNJN	50	51	51	PBS
NJ	NEW BRUNS.	WNJB	58	8	8	PBS
NJ	NEWARK	WNET	13	61	13	PBS
NJ	NEWARK	WFUT	68	53	30	TLF
NJ	NEWTON	WMBC-TV	63	18	18	IND
NJ	PATERSON	WXTV	41	40	40	UNV
NJ	SECAUCUS	WWOR-TV	9	38	38	My TV
NJ	TRENTON	WNJT	52	43	43	PBS
NJ	VINELAND	WUVP	65	66	29	UNV
NJ	W. MILFORD	WFME-TV	66	29	29	ED
NJ	WILDWOOD	WMGM-TV	40	36	36	NBC
NM	**ALBUQUERQUE**	**KOB -TV**	**4**	**26**	**26**	**NBC**
NM	ALBUQUERQUE	KNME-TV	5	35	35	PBS
NM	ALBUQUERQUE	KOAT-TV	7	21	7	ABC
NM	ALBUQUERQUE	KRQE	13	16	13	CBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
NM	ALBUQUERQUE	KTFQ-TV	14	22	22	TLF
NM	ALBUQUERQUE	KNAT	23	24	24	IND
NM	ALBUQUERQUE	KAZQ	32	17	17	IND
NM	ALBUQUERQUE	KLUZ-TV	41	42	42	UNV
NM	ALBUQUERQUE	KASY	50	45	45	My TV
NM	CARLSBAD	KOCT-TV	6	19	19	ABC
NM	CARLSBAD	KTEL-TV	25	25	25	TLM
NM	CLOVIS	KVIH-TV	12	20	20	ABC
NM	FARMINGTON	KOFT	3	8	8	ABC
NM	FARMINGTON	KOBF-TV	12	17	12	NBC
NM	HOBBS	KUPT	29	16	29	My TV
NM	LAS CRUCES	KRWG-TV	22	23	23	PBS
NM	LAS CRUCES	KTDO	48	47	47	TLM
NM	PORTALES	KENW	3	32	32	PBS
NM	ROSWELL	KOBR-TV	8	38	8	NBC
NM	ROSWELL	KBIM-TV	10	41	10	CBS
NM	ROSWELL	KRWB-TV	21	21	21	CW
NM	ROSWELL	KRPV	27	28	27	REL
NM	SANTA FE	KASA-TV	2	27	27	FOX
NM	SANTA FE	KCHF	11	10	10	IND
NM	SANTA FE	KWBQ	19	29	29	CW
NM	SANTA FE	KNMD-TV		9	9	PBS
NM	SILVER CITY	KOBG-TV	6	26	12	NBC
NM	SILVER CITY	KOVT	10	12	10	ABC
NV	**ELKO**	**KENV**	**10**	**10**	**10**	**NBC**
NV	ELY	KVNV	3	3	3	NBC
NV	ELY	KBNY	6	27	27	CP
NV	GOLDFIELD	KEGS	7	50	50	IND
NV	HENDERSON	KVVU-TV	5	9	9	FOX
NV	LAS VEGAS	KVBC	3	2	2	NBC
NV	LAS VEGAS	KLAS-TV	8	7	7	CBS
NV	LAS VEGAS	KLVX	10	11	11	PBS
NV	LAS VEGAS	KTNV-TV	13	12	13	ABC
NV	LAS VEGAS	KINC	15	16	16	UNV
NV	LAS VEGAS	KVMY	21	22	22	My TV
NV	LAS VEGAS	KVCW	33	29	29	CW
NV	LAUGHLIN	KMCC	34	32	32	NBC

Refer to page 224 for more information.

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
NV	PARADISE	KBLR	39	40	40	TLM
NV	RENO	KTVN	2	13	13	CBS
NV	RENO	KRNV-TV	4	7	7	NBC
NV	RENO	KNPB	5	15	15	PBS
NV	RENO	KOLO-TV	8	9	8	ABC
NV	RENO	KRXI	11	44	44	FOX
NV	RENO	KAME-TV	21	20	20	My TV
NV	RENO	KREN-TV	27	26	26	CW
NV	TONOPAH	KBMO-TV	9	9	9	CP
NV	WINNEMUCCA	KWNV	7	7	7	NBC
NY	**ALBANY**	**WTEN**	**10**	**26**	**26**	**ABC**
NY	ALBANY	WNYT-TV	13	12	12	NBC
NY	ALBANY	WXXA-TV	23	7	7	FOX
NY	AMSTERDAM	WYPX	55	50	50	ION
NY	BATAVIA	WPXJ-TV	51	53	23	ION
NY	BATH	WFBT	14	14	14	CP
NY	BINGHAMTON	WBNG-TV	12	7	7	CBS
NY	BINGHAMTON	WIVT	34	4	34	ABC
NY	BINGHAMTON	WICZ-TV	40	8	8	FOX
NY	BINGHAMTON	WSKG	46	42	42	PBS
NY	BUFFALO	WGRZ-TV	2	33	33	NBC
NY	BUFFALO	WIVB-TV	4	39	39	CBS
NY	BUFFALO	WKBW-TV	7	38	38	ABC
NY	BUFFALO	WNED-TV	17	43	43	PBS
NY	BUFFALO	WNLO	23	32	32	CW
NY	BUFFALO	WUTV	29	14	14	FOX
NY	BUFFALO	WNYO-TV	49	34	34	My TV
NY	CARTHAGE	WWNY-TV	7	35	7	CBS
NY	CORNING	WSKA	30	30	30	PBS
NY	CORNING	WYDC-TV	48	50	48	FOX
NY	ELMIRA	WETM-TV	18	2	18	NBC
NY	ELMIRA	WENY-TV	36	55	36	ABC
NY	GARDEN CITY	WLIW	21	22	21	PBS
NY	ITHACA	WNYI	52	20	20	UNV
NY	JAMESTOWN	WNYB	26	27	26	REL
NY	KINGSTON	WRNN-TV		48	48	IND
NY	NEW YORK	WCBS-TV	2	56	33	CBS

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
NY	NEW YORK	WNBC	4	28	28	NBC
NY	NEW YORK	WNYW	5	44	44	FOX
NY	NEW YORK	WABC-TV	7	45	7	ABC
NY	NEW YORK	WPIX	11	33	11	CW
NY	NEW YORK	WNYE-TV	25	24	24	PBS
NY	NEW YORK	WPXN-TV	31	30	31	ION
NY	NORTH POLE	WPTZ	5	14	14	NBC
NY	NORWOOD	WNPI-TV	18	23	23	PBS
NY	PLATTSBURGH	WCFE-TV	57	38	38	PBS
NY	POUGHKEEPSIE	WTBY	54	27	27	IND
NY	RIVERHEAD	WLNY	55	57	47	IND
NY	ROCHESTER	WROC-TV	8	45	45	CBS
NY	ROCHESTER	WHEC-TV	10	58	10	NBC
NY	ROCHESTER	WHAM	13	59	13	ABC
NY	ROCHESTER	WXXI-TV	21	16	16	PBS
NY	ROCHESTER	WUHF	31	28	28	FOX
NY	SARANAC LAKE	WCWF	40	40	40	ION
NY	SCHENECTADY	WRGB	6	39	6	CBS
NY	SCHENECTADY	WMHT	17	34	34	PBS
NY	SCHENECTADY	WCWN	45	43	43	CW
NY	SMITHTOWN	WFTY	67	23	23	TLF
NY	SPRINGVILLE	WNGS	67	46	7	IND
NY	SYRACUSE	WSTM-TV	3	54	24	NBC
NY	SYRACUSE	WTVH	5	47	47	CBS
NY	SYRACUSE	WSYR	9	17	17	ABC
NY	SYRACUSE	WCNY-TV	24	25	25	PBS
NY	SYRACUSE	WNYS-TV	43	44	44	My TV
NY	SYRACUSE	WSPX	56	15	15	ION
NY	SYRACUSE	WSYT	68	19	19	FOX
NY	UTICA	WKTV	2	29	29	NBC
NY	UTICA	WUTR	20	30	30	ABC
NY	UTICA	WFXV	33	27	27	FOX
NY	WATERTOWN	WPBS-TV	16	41	41	PBS
NY	WATERTOWN	WWTI	50	21	21	ABC
OH	**AKRON**	**WVPX**	**23**	**59**	**23**	**ION**
OH	AKRON	WEAO	49	50	50	PBS
OH	AKRON	WBNX-TV	55	30	30	CW

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
OH	ALLIANCE	WNEO	45	46	45	PBS
OH	ATHENS	WOUB-TV	20	27	27	PBS
OH	BOWL. GREEN	WBGU-TV	27	56	27	PBS
OH	CAMBRIDGE	WOUC-TV	44	35	35	PBS
OH	CANTON	WDLI	17	39	39	IND
OH	CANTON	WOAC	67	47	47	IND
OH	CHILLICOTHE	WWHO	53	46	46	CW
OH	CINCINNATI	WLWT	5	35	35	NBC
OH	CINCINNATI	WCPO-TV	9	10	10	ABC
OH	CINCINNATI	WKRC-TV	12	31	12	CBS
OH	CINCINNATI	WCET	48	34	34	PBS
OH	CINCINNATI	WSTR-TV	64	33	33	My TV
OH	CLEVELAND	WKYC-TV	3	2	17	NBC
OH	CLEVELAND	WEWS	5	15	15	ABC
OH	CLEVELAND	WJW	8	31	8	FOX
OH	CLEVELAND	WVIZ-TV	25	26	26	PBS
OH	CLEVELAND	WQHS-TV	61	34	34	UNV
OH	COLUMBUS	WCMH-TV	4	14	14	NBC
OH	COLUMBUS	WSYX	6	13	13	ABC
OH	COLUMBUS	WBNS-TV	10	21	21	CBS
OH	COLUMBUS	WTTE	28	36	36	FOX
OH	COLUMBUS	WOSU-TV	34	38	38	PBS
OH	DAYTON	WDTN	2	50	50	NBC
OH	DAYTON	WHIO-TV	7	41	41	CBS
OH	DAYTON	WPTD	16	58	16	PBS
OH	DAYTON	WKEF	22	51	51	ABC
OH	DAYTON	WRGT-TV	45	30	30	FOX
OH	LIMA	WLIO	35	8	8	NBC
OH	LIMA	WTLW	44	47	44	IND
OH	LORAIN	WUAB	43	28	28	My TV
OH	MANSFIELD	WMFD-TV	68	12	12	IND
OH	NEWARK	WSFJ-TV	51	24	24	IND
OH	OXFORD	WPTO	14	28	28	PBS
OH	PORTSMOUTH	WQCW	30	17	17	CW
OH	PORTSMOUTH	WPBO-TV	42	43	43	PBS
OH	SANDUSKY	WGGN-TV	52	42	42	IND
OH	SH. HEIGHTS	WOIO	19	10	10	CBS

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
OH	SPRINGFIELD	WBDT-TV	26	18	26	CW
OH	STEUBENVILLE	WTOV-TV	9	57	9	NBC
OH	TOLEDO	WTOL-TV	11	17	11	CBS
OH	TOLEDO	WTVG	13	19	13	ABC
OH	TOLEDO	WNWO-TV	24	49	49	NBC
OH	TOLEDO	WGTE-TV	30	29	29	PBS
OH	TOLEDO	WUPW	36	46	46	FOX
OH	TOLEDO	WLMB	40	5	5	IND
OH	YOUNGSTOWN	WFMJ-TV	21	20	20	NBC
OH	YOUNGSTOWN	WKBN-TV	27	41	41	CBS
OH	YOUNGSTOWN	WYTV	33	36	36	ABC
OH	ZANESVILLE	WHIZ-TV	18	40	40	NBC
OK	**ADA**	**KTEN**	**10**	**26**	**26**	**NBC**
OK	BARTLESVILLE	KDOR	17	15	17	IND
OK	CHEYENNE	KWET	12	8	8	PBS
OK	CLAREMORE	KRSC-TV	35	36	36	ED
OK	EUFAULA	KOET	3	31	31	PBS
OK	LAWTON	KSWO-TV	7	11	11	ABC
OK	MUSKOGEE	KQCW	19	20	20	CW
OK	NORMAN	KOCM	46	46	46	IND
OK	OK. CITY	KFOR-TV	4	27	27	NBC
OK	OK. CITY	KOCO-TV	5	7	7	ABC
OK	OK. CITY	KWTV	9	39	9	CBS
OK	OK. CITY	KETA	13	32	13	PBS
OK	OK. CITY	KTBO-TV	14	15	15	REL
OK	OK. CITY	KOKH	25	24	24	FOX
OK	OK. CITY	KOCB-TV	34	33	33	CW
OK	OK. CITY	KAUT-TV	43	40	40	My TV
OK	OK. CITY	KSBI	52	51	51	IND
OK	OK. CITY	KOPX	62	50	50	ION
OK	OKMULGEE	KTPX	44	28	28	ION
OK	SHAWNEE	KTUZ	30	29	29	TLM
OK	TULSA	KJRH	2	56	8	NBC
OK	TULSA	KOTV-TV	6	55	45	CBS
OK	TULSA	KTUL	8	10	10	ABC
OK	TULSA	KOED-TV	11	38	11	PBS
OK	TULSA	KOKI-TV	23	22	22	FOX

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
OK	TULSA	KMYT-TV	41	42	42	My TV
OK	TULSA	KWHB	47	48	47	IND
OK	TULSA	KGEB	53	49	49	IND
OK	WOODWARD	KUOK	35	35	35	UNV
OR	**BEND**	**KOAB-TV**	**3**	**11**	**11**	**PBS**
OR	BEND	KTVZ	21	18	21	NBC
OR	BEND	KOHD		51	51	ABC
OR	COOS BAY	KCBY-TV	11	21	11	CBS
OR	COOS BAY	KMCB	23	22	22	NBC
OR	CORVALLIS	KOAC-TV	7	39	7	PBS
OR	EUGENE	KEZI	9	44	9	ABC
OR	EUGENE	KVAL-TV	13	25	13	CBS
OR	EUGENE	KMTR-TV	16	17	17	NBC
OR	EUGENE	KEPB-TV	28	29	29	PBS
OR	EUGENE	KLSR-TV	34	31	31	FOX
OR	GRANTS PASS	KBLN	30	30	30	REL
OR	KLAMATH FALLS	KOTI	2	13	13	NBC
OR	KLAMATH FALLS	KFTS	22	33	33	PBS
OR	KLAMATH FALLS	KDKF	31	29	29	ABC
OR	LA GRANDE	KTVR	13	5	13	PBS
OR	LA GRANDE	KUNP	16	29	29	UNV
OR	MEDFORD	KOBI	5	15	5	NBC
OR	MEDFORD	KSYS	8	42	8	PBS
OR	MEDFORD	KTVL	10	35	10	CBS
OR	MEDFORD	KDRV	12	38	12	ABC
OR	MEDFORD	KMVU-TV	26	27	26	FOX
OR	PENDLETON	KFFX	11	8	11	FOX
OR	PORTLAND	KATU	2	43	43	ABC
OR	PORTLAND	KOIN-TV	6	40	40	CBS
OR	PORTLAND	KGW -TV	8	46	8	NBC
OR	PORTLAND	KOPB-TV	10	27	10	PBS
OR	PORTLAND	KPTV	12	30	12	FOX
OR	PORTLAND	KNMT-TV	24	45	45	IND
OR	ROSEBURG	KPIC	4	19	19	CBS
OR	ROSEBURG	KTVC	36	18	18	IND
OR	ROSEBURG	KTCW	46	45	45	NBC
OR	SALEM	KPXG	22	4	22	ION

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
OR	SALEM	KRCW-TV	32	33	33	CW
PA	**ALLENTOWN**	**WLVT-TV**	**39**	**62**	**39**	**PBS**
PA	ALLENTOWN	WFMZ-TV	69	46	46	IND
PA	ALTOONA	WTAJ-TV	10	32	32	CBS
PA	ALTOONA	WATM-TV	23	24	24	ABC
PA	ALTOONA	WKBS-TV	47	46	46	IND
PA	BETHLEHEM	WBPH-TV	60	9	9	IND
PA	CLEARFIELD	WPSU-TV	3	15	15	PBS
PA	ERIE	WICU-TV	12	52	12	NBC
PA	ERIE	WJET-TV	24	58	24	ABC
PA	ERIE	WSEE	35	16	16	CBS
PA	ERIE	WQLN-TV	54	50	50	PBS
PA	ERIE	WFXP	66	22	22	FOX
PA	GREENSBURG	WPCB-TV	40	50	50	IND
PA	HARRISBURG	WHP -TV	21	4	21	CBS
PA	HARRISBURG	WHTM-TV	27	10	10	ABC
PA	HARRISBURG	WITF-TV	33	36	36	PBS
PA	HAZLETON	WOLF-TV	56	45	45	FOX
PA	JEANNETTE	WPCW	19	49	11	CW
PA	JOHNSTOWN	WJAC-TV	6	34	34	NBC
PA	JOHNSTOWN	WWCP-TV	8	29	8	FOX
PA	LANCASTER	WGAL-TV	8	58	8	NBC
PA	LANCASTER	WLYH-TV	15	23	23	CW
PA	PHILADELPHIA	KYW -TV	3	26	26	CBS
PA	PHILADELPHIA	WPVI-TV	6	64	6	ABC
PA	PHILADELPHIA	WCAU	10	67	34	NBC
PA	PHILADELPHIA	WPHL-TV	17	54	17	My TV
PA	PHILADELPHIA	WTXF-TV	29	42	42	FOX
PA	PHILADELPHIA	WYBE	35	34	35	PBS
PA	PHILADELPHIA	WPSG	57	32	32	CW
PA	PITTSBURGH	KDKA-TV	2	25	25	CBS
PA	PITTSBURGH	WTAE-TV	4	51	51	ABC
PA	PITTSBURGH	WPXI	11	48	48	NBC
PA	PITTSBURGH	WQED	13	38	13	PBS
PA	PITTSBURGH	WQEX	16	26	38	PBS
PA	PITTSBURGH	WPMY	22	42	42	My TV
PA	PITTSBURGH	WPGH-TV	53	43	43	FOX

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
PA	READING	WTVE	51	25	25	REL
PA	RED LION	WGCB-TV	49	30	30	IND
PA	SCRANTON	WNEP-TV	16	49	49	ABC
PA	SCRANTON	WYOU	22	13	13	CBS
PA	SCRANTON	WSWB-TV	38	31	38	CW
PA	SCRANTON	WVIA-TV	44	41	41	PBS
PA	SCRANTON	WQPX	64	32	32	ION
PA	WILKES-BARRE	WBRE-TV	28	11	11	NBC
PA	WILLIAMSPORT	WMCN-DT	53	44	29	IND
PA	YORK	WPMT	43	47	47	FOX
PR	**AGUADA**	**WQHA-TV**	**50**	**62**	**50**	**IND**
PR	AGUADILLA	WOLE-TV	12	69	12	IND SP
PR	AGUADILLA	WELU	32	34	34	
PR	AGUADILLA	WVEO	44	17	17	IND SP
PR	ARECIBO	WCCV-TV	54	53	46	IND SP
PR	ARECIBO	WMEI	60	14	14	
PR	BAYAMON	WDWL	36	59	30	REL
PR	CAGUAS	WLII	11	56	11	UNV
PR	CAGUAS	WUJA	58	57	48	PBS
PR	CAROLINA	WRFB	52	51	51	IND
PR	FAJARDO	WORO-TV	13	33	13	IND SP
PR	FAJARDO	WRUA	34	33	33	
PR	FAJARDO	WMTJ	40	16	16	
PR	GUAYAMA	WIDP	46	45	45	REL
PR	HUMACAO	WVSN-TV	68	49	49	IND
PR	MAYAGUEZ	WIPM-TV	3	35	35	PBS
PR	MAYAGUEZ	WORA-TV	5	29	29	IND
PR	MAYAGUEZ	WOST	16	22	22	
PR	MAYAGUEZ	WNJX-TV	22	23	23	IND
PR	NARANJITO	WECN	64	18	18	REL
PR	PONCE	WSTE	7	8	7	IND SP
PR	PONCE	WSUR-TV	9	43	9	UNV
PR	PONCE	WTIN	14	15	15	IND
PR	PONCE	WKPV	20	19	19	IND
PR	PONCE	WQTO	26	25	25	PBS
PR	PONCE	WVOZ	48	47	47	IND SP
PR	SAN JUAN	WKAQ-TV	2	28	28	TLM

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
PR	SAN JUAN	WAPA-TV	4	27	27	IND SP
PR	SAN JUAN	WIPR-TV	6	55	43	PBS
PR	SAN JUAN	WTCV	18	32	32	IND SP
PR	SAN JUAN	WJPX	24	21	21	IND SP
PR	SAN JUAN	WSJU	30	31	31	IND
PR	SAN SEBASTIAN	WJWN-TV	38	39	39	IND
PR	YAUCO	WIRS	42	41	41	IND
RI	**BLOCK ISLAND**	**WPXQ**	**69**	**17**	**17**	**ION**
RI	PROVIDENCE	WJAR	10	51	51	NBC
RI	PROVIDENCE	WPRI-TV	12	13	13	CBS
RI	PROVIDENCE	WSBE-TV	36	21	21	PBS
RI	PROVIDENCE	WNAC-TV	64	54	12	FOX
SC	**ALLENDALE**	**WEBA-TV**	**14**	**33**	**33**	**PBS**
SC	ANDERSON	WMYA-TV	40	14	14	My TV
SC	BEAUFORT	WJWJ-TV	16	44	44	PBS
SC	CHARLESTON	WCBD-TV	2	50	50	NBC
SC	CHARLESTON	WCIV	4	34	34	ABC
SC	CHARLESTON	WCSC-TV	5	47	47	CBS
SC	CHARLESTON	WITV	7	49	7	PBS
SC	CHARLESTON	WTAT-TV	24	40	24	FOX
SC	CHARLESTON	WMMP	36	35	36	My TV
SC	COLUMBIA	WIS	10	41	10	NBC
SC	COLUMBIA	WLTX	19	17	17	CBS
SC	COLUMBIA	WOLO-TV	25	8	8	ABC
SC	COLUMBIA	WRLK-TV	35	32	32	PBS
SC	COLUMBIA	WZRB	47	47	47	CW
SC	COLUMBIA	WACH	57	48	48	FOX
SC	CONWAY	WHMC	23	9	9	PBS
SC	FLORENCE	WBTW	13	56	13	CBS
SC	FLORENCE	WPDE-TV	15	16	16	ABC
SC	FLORENCE	WWMB	21	20	21	CW
SC	FLORENCE	WJPM-TV	33	45	45	PBS
SC	GEORGETOWN	WPJT-DT		38	38	
SC	GREENVILLE	WYFF-TV	4	59	36	NBC
SC	GREENVILLE	WGGS-TV	16	35	16	IND
SC	GREENVILLE	WHNS	21	57	21	FOX
SC	GREENVILLE	WNTV	29	9	9	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
SC	GREENWOOD	WNEH	38	18	18	PBS
SC	HARDEEVILLE	WTGS	28	27	28	FOX
SC	MYRTLE BCH.	WMBF-TV	32	32	32	NBC
SC	MYRTLE BCH.	WFXB	43	18	18	FOX
SC	ROCK HILL	WNSC-TV	30	15	15	PBS
SC	ROCK HILL	WMYT-TV	55	39	39	My TV
SC	SPARTANBURG	WSPA-TV	7	53	7	CBS
SC	SPARTANBURG	WRET-TV	49	43	43	PBS
SC	SUMTER	WRJA-TV	27	28	28	PBS
SC	SUMTER	WKTC	63	39	39	My TV
SD	**ABERDEEN**	**KABY**	**9**	**28**	**9**	**ABC**
SD	ABERDEEN	KDSD-TV	16	17	17	PBS
SD	BROOKINGS	KESD-TV	8	18	8	PBS
SD	EAGLE BUTTE	KPSD-TV	13	25	13	PBS
SD	FLORENCE	KOTA-TV	3	2	3	ABC
SD	HURON	KTTM	12	22	12	FOX
SD	LEAD	KIVV-TV	5	29	5	FOX
SD	LEAD	KHSD-TV	11	10	10	ABC
SD	LOWRY	KQSD-TV	11	15	11	PBS
SD	MARTIN	KZSD-TV	8	23	8	PBS
SD	MITCHELL	KDLV-TV	5	26	26	NBC
SD	PIERRE	KPRY-TV	4	19	19	ABC
SD	PIERRE	KTSD-TV	10	21	10	PBS
SD	RAPID CITY	KDLO-TV	3	2	2	CBS
SD	RAPID CITY	KEVN-TV	7	18	7	FOX
SD	RAPID CITY	KBHE-TV	9	26	26	PBS
SD	RAPID CITY	KCLO-TV	15	16	16	CBS
SD	RAPID CITY	KNBN	21	21	21	NBC
SD	RELIANCE	KPLO-TV	6	13	13	CBS
SD	SIOUX FALLS	KELO-TV	11	32	11	CBS
SD	SIOUX FALLS	KSFY-TV	13	29	13	ABC
SD	SIOUX FALLS	KTTW	17	7	7	FOX
SD	SIOUX FALLS	KCSD-TV	23	24	24	PBS
SD	SIOUX FALLS	KWSD-TV	36	51	36	CW
SD	SIOUX FALLS	KDLT-TV	46	47	47	NBC
SD	VERMILLION	KUSD-TV	2	34	34	PBS
TN	**CHATTANOOGA**	**WRCB-TV**	**3**	**13**	**13**	**NBC**

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
TN	CHATTANOOGA	WTVC	9	35	9	ABC
TN	CHATTANOOGA	WDEF-TV	12	47	12	CBS
TN	CHATTANOOGA	WTCI	45	29	29	PBS
TN	CHATTANOOGA	WDSI-TV	61	40	40	FOX
TN	CLEVELAND	WFLI-TV	53	42	42	CW
TN	COOKEVILLE	WCTE	22	52	22	PBS
TN	COOKEVILLE	WNPX	28	36	36	ION
TN	CROSSVILLE	WBXX-TV	20	50	20	CW
TN	GREENEVILLE	WHTN	39	38	38	IND
TN	HENDERSONVILLE	WPXX	50	51	51	My TV
TN	JACKSON	WBBJ-TV	7	43	43	ABC
TN	JACKSON	WJKT	16	39	39	FOX
TN	JELLICO	WPXK	54	23	23	ION
TN	JOHNSON CITY	WJHL-TV	11	58	11	CBS
TN	KINGSPORT	WKPT-TV	19	27	27	ABC
TN	KNOXVILLE	WATE-TV	6	26	26	ABC
TN	KNOXVILLE	WVLT-TV	8	30	30	CBS
TN	KNOXVILLE	WBIR-TV	10	31	10	NBC
TN	KNOXVILLE	WKOP-TV	15	17	17	PBS
TN	KNOXVILLE	WTNZ-TV	43	34	34	FOX
TN	KNOXVILLE	WMAK		7	7	IND
TN	LEBANON	WJFB	66	44	44	IND
TN	LEXINGTON	WLJT-TV	11	47	47	PBS
TN	MEMPHIS	WREG-TV	3	28	28	CBS
TN	MEMPHIS	WMC -TV	5	52	5	NBC
TN	MEMPHIS	WKNO-TV	10	29	29	PBS
TN	MEMPHIS	WHBQ-TV	13	53	13	FOX
TN	MEMPHIS	WTWV	14	23	23	REL
TN	MEMPHIS	WPTY-TV	24	25	25	ABC
TN	MEMPHIS	WLMT	30	31	31	CW
TN	MEMPHIS	WPGD	50	51	51	IND
TN	MEMPHIS	NEW		10	10	PBS
TN	MURFREESBORO	WEMT	39	38	38	FOX
TN	NASHVILLE	WKRN-TV	2	27	27	ABC
TN	NASHVILLE	WSMV	4	10	10	NBC
TN	NASHVILLE	WTVF	5	56	5	CBS
TN	NASHVILLE	WNPT	8	46	8	PBS

Refer to page 224 for more information.

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
TN	NASHVILLE	WZTV	17	15	15	FOX
TN	NASHVILLE	WUXP	30	21	21	My TV
TN	NASHVILLE	WNAB	58	23	23	CW
TN	SNEEDVILLE	WETP-TV	2	41	41	PBS
TN	TAZEWELL	WVLR	48	48	48	REL
TX	**ABILENE**	**KRBC-TV**	**9**	**29**	**29**	**NBC**
TX	ABILENE	KXVA	15	15	15	FOX
TX	ABILENE	KTAB-TV	32	24	24	CBS
TX	ALVIN	KFTH	67	36	36	TLF
TX	AMARILLO	KACV-TV	2	8	8	PBS
TX	AMARILLO	KAMR-TV	4	19	19	NBC
TX	AMARILLO	KVII-TV	7	23	7	ABC
TX	AMARILLO	KFDA-TV	10	9	10	CBS
TX	AMARILLO	KCIT	14	15	15	FOX
TX	ARLINGTON	KPXD	68	42	42	ION
TX	AUSTIN	KTBC	7	56	7	FOX
TX	AUSTIN	KLRU	18	22	22	PBS
TX	AUSTIN	KVUE-TV	24	33	33	ABC
TX	AUSTIN	KXAN-TV	36	21	21	NBC
TX	AUSTIN	KEYE	42	43	43	CBS
TX	AUSTIN	KNVA	54	49	49	CW
TX	BAYTOWN	KAZH	57	41	41	Azteca
TX	BEAUMONT	KFDM-TV	6	21	21	CBS
TX	BEAUMONT	KBMT	12	50	12	ABC
TX	BEAUMONT	KITU	34	33	33	IND
TX	BELTON	KNCT	46	38	46	PBS
TX	BIG SPRING	KWAB-TV	4	33	33	NBC
TX	BLANCO	KNIC-TV	17	18	18	TLF
TX	BORGER	KEYU		31	31	UNV
TX	BROWNSVILLE	KVEO	23	24	24	NBC
TX	BRYAN	KBTX-TV	3	50	50	CBS
TX	BRYAN	KYLE-TV	28	29	28	FOX
TX	COL. STATION	KAMU-TV	15	12	12	PBS
TX	CONROE	KPXB	49	5	32	ION
TX	CONROE	KTBU	55	42	42	IND
TX	CORP. CHRISTI	KIII	3	8	8	ABC
TX	CORP. CHRISTI	KRIS-TV	6	13	13	NBC

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Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
TX	CORP. CHRISTI	KZTV	10	18	10	CBS
TX	CORP. CHRISTI	KEDT-TV	16	23	23	PBS
TX	CORP. CHRISTI	KORO	28	27	27	UNV
TX	CORP. CHRISTI	KUQI	38	38	38	FOX
TX	DALLAS	KDFW	4	35	35	FOX
TX	DALLAS	WFAA-TV	8	9	8	ABC
TX	DALLAS	KERA-TV	13	14	14	PBS
TX	DALLAS	KDFI-TV	27	36	36	My TV
TX	DALLAS	KDAF	33	32	32	CW
TX	DALLAS	KXTX-TV	39	40	40	IND
TX	DALLAS	KDTX-TV	58	45	45	IND
TX	DECATUR	KMPX	29	30	30	IND SP
TX	DEL RIO	KTRG	10	28	28	IND SP
TX	DENTON	KDTN	2	43	43	IND
TX	EAGLE PASS	KVAW	16	18	24	IND
TX	EL PASO	KDBC-TV	4	18	18	CBS
TX	EL PASO	KVIA-TV	7	17	7	ABC
TX	EL PASO	KTSM-TV	9	16	9	NBC
TX	EL PASO	KCOS	13	30	13	PBS
TX	EL PASO	KFOX-TV	14	15	15	FOX
TX	EL PASO	KINT-TV	26	25	25	UNV
TX	EL PASO	KSCE-TV	38	39	39	IND
TX	EL PASO	KTFN	65	51	51	TLF
TX	FARWELL	KPTF	18	18	18	REL
TX	FORT WORTH	KXAS-TV	5	41	41	NBC
TX	FORT WORTH	KTVT	11	19	11	CBS
TX	FORT WORTH	KTXA	21	18	18	IND
TX	FORT WORTH	KFWD	52	51	9	IND
TX	FREDERICKSBURG	KCWX	2	5	5	CW
TX	GALVESTON	KLTJ	22	23	23	REL
TX	GALVESTON	KTMD	47	48	48	TLM
TX	GARLAND	KUVN-TV	23	24	23	UNV
TX	GREENVILLE	KTAQ-TV	47	46	46	IND
TX	HARLINGEN	KGBT-TV	4	31	31	CBS
TX	HARLINGEN	KLUJ	44	34	34	ED
TX	HARLINGEN	KMBH-TV	60	38	38	PBS
TX	HOUSTON	KPRC-TV	2	35	35	NBC

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
TX	HOUSTON	KUHT	8	9	8	PBS
TX	HOUSTON	KHOU-TV	11	31	11	CBS
TX	HOUSTON	KTRK-TV	13	32	13	ABC
TX	HOUSTON	KETH	14	24	24	IND
TX	HOUSTON	KTXH	20	19	19	My TV
TX	HOUSTON	KRIV	26	27	26	FOX
TX	HOUSTON	KIAH	39	38	38	CW
TX	HOUSTON	KZJL	61	44	44	IND SP
TX	IRVING	KSTR-TV	49	48	48	TLF
TX	JACKSONVILLE	KETK-TV	56	22	22	NBC
TX	KATY	KNWS-TV	51	52	47	IND
TX	KERRVILLE	KMYS	35	32	32	My TV
TX	KILLEEN	KAKW	62	13	13	UNV
TX	LAKE DALLAS	KLDT	55	54	39	IND
TX	LAREDO	KGNS-TV	8	15	8	NBC
TX	LAREDO	KVTV	13	14	13	CBS
TX	LAREDO	KLDO-TV	27	19	19	UNV
TX	LLANO	KXAM-TV	14	27	27	NBC
TX	LONGVIEW	KFXK-TV	51	31	31	FOX
TX	LONGVIEW	KCEB	54	38	38	CW
TX	LUBBOCK	KTXT-TV	5	39	39	PBS
TX	LUBBOCK	KCBD-TV	11	9	11	NBC
TX	LUBBOCK	KLBK-TV	13	40	40	CBS
TX	LUBBOCK	KPTB-TV	16	25	16	REL
TX	LUBBOCK	KAMC	28	27	27	ABC
TX	LUBBOCK	KJTV	34	35	35	FOX
TX	LUFKIN	KTRE	9	11	9	ABC
TX	MCALLEN	KNVO	48	49	49	UNV
TX	MIDLAND	KMID	2	26	26	ABC
TX	MIDLAND	KUPB	18	18	18	UNV
TX	NACOGDOCHES	KYTX	19	18	18	CBS
TX	ODESSA	KOSA-TV	7	31	7	CBS
TX	ODESSA	KWES	9	13	9	NBC
TX	ODESSA	KPEJ	24	23	23	FOX
TX	ODESSA	KWWT	30	30	30	CW
TX	ODESSA	KPBT-TV	36	38	38	PBS
TX	ODESSA	KMLM	42	43	42	REL

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State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
TX	PORT ARTHUR	KBTV	4	40	40	NBC
TX	RIO GR. CITY	KTLM	40	20	20	TLM
TX	ROSENBERG	KXLN-TV	45	46	45	UNV
TX	SAN ANGELO	KSAN-TV	3	16	16	NBC
TX	SAN ANGELO	KIDY	6	19	19	FOX
TX	SAN ANGELO	KLST	8	11	11	CBS
TX	SAN ANTONIO	WOAI	4	58	48	NBC
TX	SAN ANTONIO	KENS-TV	5	55	39	CBS
TX	SAN ANTONIO	KLRN-TV	9	8	9	PBS
TX	SAN ANTONIO	KSAT-TV	12	48	12	ABC
TX	SAN ANTONIO	KHCE	23	16	16	REL
TX	SAN ANTONIO	KABB	29	30	30	FOX
TX	SAN ANTONIO	KWEX-TV	41	39	41	UNV
TX	SAN ANTONIO	KVDA	60	38	38	TLM
TX	SHERMAN	KXII	12	20	12	CBS
TX	SNYDER	KPCB	17	10	17	REL
TX	SWEETWATER	KTXS-TV	12	20	20	ABC
TX	TEMPLE	KCEN-TV	6	9	9	NBC
TX	TEXARKANA	KTAL-TV	6	15	15	NBC
TX	TYLER	KLTV	7	10	7	ABC
TX	UVALDE	KPXL	26	26	26	IND
TX	VICTORIA	KVCT	19	11	11	FOX
TX	VICTORIA	KAVU-TV	25	15	15	ABC
TX	WACO	KWTX-TV	10	53	10	CBS
TX	WACO	KXXV	25	26	26	ABC
TX	WACO	KWBU	34	20	20	PBS
TX	WACO	KWKT	44	57	44	FOX
TX	WESLACO	KRGV-TV	5	13	13	ABC
TX	WICHITA FALLS	KFDX-TV	3	28	28	NBC
TX	WICHITA FALLS	KAUZ-TV	6	22	22	CBS
TX	WICHITA FALLS	KJTL	18	15	15	FOX
TX	WOLFFORTH	KLCW-TV	22	43	43	CW
UT	**CEDAR CITY**	**KCSG**	**4**	**14**	**14**	**IND**
UT	LOGAN	KUTF	12	12	12	TLF
UT	OGDEN	KUEN	9	36	36	PBS
UT	OGDEN	KPNZ	24	24	24	IND
UT	OGDEN	KUCW	30	48	48	CW

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
UT	PRICE	KCBU	3	11	11	IND
UT	PROVO	KBYU-TV	11	44	44	PBS
UT	PROVO	KUPX	16	29	29	ION
UT	PROVO	KCBU	32	3	32	IND
UT	RICHFIELD	KUES		19	19	PBS
UT	SALT LAKE CITY	KUTV	2	34	34	CBS
UT	SALT LAKE CITY	KTVX	4	40	40	ABC
UT	SALT LAKE CITY	KSL -TV	5	38	38	NBC
UT	SALT LAKE CITY	KUED	7	42	42	PBS
UT	SALT LAKE CITY	KSTU	13	28	13	FOX
UT	SALT LAKE CITY	KJZZ-TV	14	46	46	My TV
UT	SALT LAKE CITY	KTMW	20	20	20	IND
UT	ST. GEORGE	KUSG	12	9	9	CBS
UT	ST. GEORGE	KUEW		18	18	PBS
UT	VERNAL	KBCJ	6	16	16	CP
VA	**ARLINGTON**	**WFDC-TV**	**14**	**15**	**15**	**UNV**
VA	ASHLAND	WUPV	65	47	47	CW
VA	BRISTOL	WCYB-TV	5	28	5	NBC
VA	CHARLOTTESVILLE	WCAV-TV	19	19	19	CBS
VA	CHARLOTTESVILLE	WVIR-TV	29	32	32	NBC
VA	CHARLOTTESVILLE	WHTJ	41	46	46	PBS
VA	DANVILLE	WDRL	24	41	24	IND
VA	FAIRFAX	WNVC	56	57	24	ED
VA	FRONT ROYAL	WVPY	42	21	21	PBS
VA	GOLDVEIN	WNVT		30	30	ED
VA	GRUNDY	WLFG	68	49	49	IND
VA	HAMPTON	WVEC-TV	13	41	13	ABC
VA	HAMPTON-NORFOLK	WHRO-TV	15	16	16	PBS
VA	HARRISONBURG	WHSV-TV	3	49	49	ABC
VA	LYNCHBURG	WSET-TV	13	34	13	ABC
VA	LYNCHBURG	WWCW	21	20	20	CW
VA	MANASSAS	WPXW	66	43	34	ION
VA	MARION	WMSY-TV	52	42	42	PBS
VA	NORFOLK	WTKR-TV	3	40	40	CBS
VA	NORFOLK	WTVZ	33	38	33	My TV
VA	NORFOLK	WPXV	49	46	46	ION
VA	NORTON	WSBN-TV	47	32	32	PBS

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
VA	PETERSBURG	WRIC-TV	8	22	22	ABC
VA	PORTSMOUTH	WAVY-TV	10	31	31	NBC
VA	PORTSMOUTH	WGNT	27	50	50	CW
VA	RICHMOND	WTVR-TV	6	25	25	CBS
VA	RICHMOND	WWBT	12	54	12	NBC
VA	RICHMOND	WCVE-TV	23	42	42	PBS
VA	RICHMOND	WRLH-TV	35	26	26	FOX
VA	RICHMOND	WCVW	57	44	44	PBS
VA	ROANOKE	WDBJ	7	18	18	CBS
VA	ROANOKE	WSLS-TV	10	30	30	NBC
VA	ROANOKE	WBRA-TV	15	3	3	PBS
VA	ROANOKE	WFXR	27	17	17	FOX
VA	ROANOKE	WPXR	38	36	36	ION
VA	STAUNTON	WVPT	51	11	11	PBS
VA	VIRGINIA BCH.	WHRE	21	7	7	REL
VA	VIRGINIA BCH.	WVBT	43	29	29	FOX
VI	**CHARLOTTE AMALIE**	**WTJX-TV**	**12**	**44**	**44**	**PBS**
VI	CHARLOTTE AMALIE	WVXF-TV	17	48	17	CBS
VI	CHARLOTTE AMALIE	WZVI		43	43	ABC
VI	CHRISTIANSTED	WSVI	8	20	20	ABC
VI	CHRISTIANSTED	WVIF	15	15	15	Silent
VI	CHRISTIANSTED	WCVI-TV	39	23	23	CW
VT	**BURLINGTON**	**WCAX-TV**	**3**	**53**	**22**	**CBS**
VT	BURLINGTON	WVNY	22	13	13	ABC
VT	BURLINGTON	WETK	33	32	32	PBS
VT	BURLINGTON	WFFF-TV	44	43	43	FOX
VT	HARTFORD	WNNE-TV	31	25	25	NBC
VT	RUTLAND	WVER	28	9	9	PBS
VT	ST. JOHNSBURY	WVTB	20	18	18	PBS
VT	WINDSOR	WVTA	41	24	24	PBS
WA	**BELLEVUE**	**KWPX**	**33**	**32**	**33**	**ION**
WA	BELLEVUE	KUNS-TV	51	50	50	UNV
WA	BELLINGHAM	KVOS-TV	12	35	35	IND
WA	BELLINGHAM	KBCB	24	19	19	IND
WA	CENTRALIA	KCKA	15	19	19	PBS
WA	EVERETT	KONG-TV	16	31	31	IND
WA	KENNEWICK	KVEW	42	44	44	ABC

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
WA	PASCO	KEPR-TV	19	18	18	CBS
WA	PULLMAN	KWSU-TV	10	17	10	PBS
WA	PULLMAN	KQUP	24	24	24	IND
WA	RICHLAND	KNDU	25	26	26	NBC
WA	RICHLAND	KTNW	31	38	38	PBS
WA	SEATTLE	KOMO-TV	4	38	38	ABC
WA	SEATTLE	KING-TV	5	48	48	NBC
WA	SEATTLE	KIRO-TV	7	39	39	CBS
WA	SEATTLE	KCTS-TV	9	41	9	PBS
WA	SEATTLE	KMYQ	22	25	25	My TV
WA	SEATTLE	KHCV	45	44	44	IND
WA	SPOKANE	KREM-TV	2	20	20	CBS
WA	SPOKANE	KXLY-TV	4	13	13	ABC
WA	SPOKANE	KHQ-TV	6	15	7	NBC
WA	SPOKANE	KSPS-TV	7	8	8	PBS
WA	SPOKANE	KSKN	22	36	36	CW
WA	SPOKANE	KAYU-TV	28	30	28	FOX
WA	SPOKANE	KGPX	34	34	34	ION
WA	TACOMA	KSTW	11	36	11	CW
WA	TACOMA	KCPQ	13	18	13	FOX
WA	TACOMA	KTBW-TV	20	14	14	IND
WA	TACOMA	KBTC-TV	28	27	27	PBS
WA	TACOMA	KWDK	56	42	42	ED
WA	VANCOUVER	KPDX	49	48	30	My TV
WA	WALLA WALLA	KCWK	9	9	9	Defunct
WA	YAKIMA	KNDO	23	16	16	NBC
WA	YAKIMA	KIMA-TV	29	33	33	CBS
WA	YAKIMA	KAPP	35	14	14	ABC
WA	YAKIMA	KYVE	47	21	21	PBS
WI	**ANTIGO**	**WTPX**		**46**	**46**	**ION**
WI	APPLETON	WACY	32	27	27	My TV
WI	CHIPPEWA FALLS	WEUX	48	49	49	FOX
WI	CRANDON	WBIJ	4	12	12	REL
WI	EAGLE RIVER	WYOW	34	28	28	ABC
WI	EAU CLAIRE	WEAU-TV	13	39	13	NBC
WI	EAU CLAIRE	WQOW-TV	18	15	15	ABC
WI	FOND DU LAC	WWAZ-TV	68	44	44	IND

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
WI	GREEN BAY	WBAY-TV	2	23	23	ABC
WI	GREEN BAY	WFRV-TV	5	56	39	CBS
WI	GREEN BAY	WLUK-TV	11	51	11	FOX
WI	GREEN BAY	WGBA	26	41	41	NBC
WI	GREEN BAY	WPNE	38	42	42	PBS
WI	JANESVILLE	WBUW	57	32	32	CW
WI	KENOSHA	WPXE	55	40	40	ION
WI	LA CROSSE	WKBT	8	41	8	CBS
WI	LA CROSSE	WXOW-TV	19	14	14	ABC
WI	LA CROSSE	WLAX	25	17	17	FOX
WI	LA CROSSE	WHLA-TV	31	30	30	PBS
WI	MADISON	WISC-TV	3	50	50	CBS
WI	MADISON	WMTV	15	19	19	NBC
WI	MADISON	WHA -TV	21	20	20	PBS
WI	MADISON	WKOW-TV	27	26	26	ABC
WI	MADISON	WMSN-TV	47	11	11	FOX
WI	MAYVILLE	WWRS	52	43	43	IND
WI	MENOMONIE	WHWC-TV	28	27	27	PBS
WI	MILWAUKEE	WTMJ-TV	4	28	28	NBC
WI	MILWAUKEE	WITI	6	33	33	FOX
WI	MILWAUKEE	WMVS	10	8	8	PBS
WI	MILWAUKEE	WISN-TV	12	34	34	ABC
WI	MILWAUKEE	WVTV	18	61	18	CW
WI	MILWAUKEE	WCGV-TV	24	25	25	My TV
WI	MILWAUKEE	WVCY-TV	30	22	22	REL
WI	MILWAUKEE	WMVT	36	35	35	PBS
WI	MILWAUKEE	WDJT-TV	58	46	46	CBS
WI	PARK FALLS	WLEF-TV	36	47	36	PBS
WI	RACINE	WBME-TV	49	48	48	IND
WI	RHINELANDER	WJFW-TV	12	16	16	NBC
WI	SUPERIOR	KBJR-TV	6	19	19	NBC
WI	SURING	WIWB	14	21	21	CW
WI	WAUSAU	WSAW-TV	7	40	7	CBS
WI	WAUSAU	WAOW-TV	9	29	9	ABC
WI	WAUSAU	WHRM-TV	20	24	24	PBS
WI	WITTENBERG	WPXE	55	40	50	ION
WV	**BLUEFIELD**	**WVVA**	**6**	**46**	**46**	**NBC**

Refer to page 224 for more information.

Station List

State	City	Station Call Letters	NTSC Ch. (Virtual Ch.)	DTV Companion (Pre-2-17-09)	Final DTV (Post-2-17-09)	Primary Net Affiliation
WV	BLUEFIELD	WLFB	40	14	40	IND
WV	CHARLESTON	WCHS-TV	8	41	41	ABC
WV	CHARLESTON	WVAH-TV	11	19	19	FOX
WV	CHARLESTON	WLPX-TV	29	39	39	ION
WV	CLARKSBURG	WBOY-TV	12	52	12	NBC
WV	CLARKSBURG	WVFX	46	10	10	FOX
WV	GRANDVIEW	WSWP-TV	9	53	10	PBS
WV	HUNTINGTON	WSAZ-TV	3	23	23	NBC
WV	HUNTINGTON	WOWK-TV	13	47	13	CBS
WV	HUNTINGTON	WPBY-TV	33	34	34	PBS
WV	LEWISBURG	WVNS	59	8	8	CBS
WV	MARTINSBURG	WWPX	60	12	12	ION
WV	MORGANTOWN	WNPB-TV	24	33	33	PBS
WV	OAK HILL	WOAY-TV	4	50	50	ABC
WV	PARKERSBURG	WTAP-TV	15	49	49	NBC
WV	WESTON	WDTV	5	6	5	CBS
WV	WHEELING	WTRF-TV	7	32	7	CBS
WY	**CASPER**	**KTWO-TV**	**2**	**17**	**17**	**ABC**
WY	CASPER	KPTW	6	6	6	PBS
WY	CASPER	KCWY	13	12	12	NBC
WY	CASPER	KGWC-TV	14	15	14	CBS
WY	CASPER	KFNB	20	18	20	FOX
WY	CHEYENNE	KGWN	5	30	30	CBS
WY	CHEYENNE	KLWY	27	28	27	FOX
WY	CHEYENNE	KDEV	33	11	11	ABC
WY	CHEYENNE	KQCK	33	11	11	ABC
WY	JACKSON	KJWY	2	2	2	NBC
WY	JACKSON	KBEO	11	11	11	CW
WY	LANDER	KCWC-TV	4	8	8	PBS
WY	LANDER	KGWL-TV	5	7	7	CBS
WY	LARAMIE	KWYP-TV	8	8	8	PBS
WY	RAWLINS	KFNR	11	9	9	FOX
WY	RIVERTON	KFNE	10	16	10	FOX
WY	ROCK SPR.	KGWR-TV	13	13	13	CBS
WY	SHERIDAN	KSWY	7	7	7	NBC
WY	SHERIDAN	KSGW-TV	12	13	13	ABC

Refer to page 224 for more information.

Acronyms

ACA	Apartment Complex Amplifier
AD	Agile Demodulator
AM	Agile Modulator
AMCM	Agile Micro Modulator
AMT	Addressable Multi-Tap
AP	Agile Processor
AQD	ATSC/QAM Demodulator
AQM	Agile QAM Modulator
AQT	ATSC/QAM Transcoder
ATX	Addressable Transmitter
BIDA	Broadband Indoor Distribution Amplifier
BPF	Bandpass Filter
CAM	Channelized Agile A/V Modulator
CAP	Channelized Agile A/V Processor
CDSR	Commercial Digital Satellite Receiver
DA	Distribution Amplifier
DAP	Digital to Analog Processor
DC	Directional Coupler
DSR	Digital Satellite Receiver
FRDA	Fiber Receiver/Distribution Amplifier
FSM	Field Strength Meter
IRD	Integrated Receiver Decoder
ITX	Intelligent Transmitter
LA	Launch Amplifier
LNBF	Low Noise Block Converter Feed
MAVM	Masterline Audio/Video Modulator
MICM	Micro-Modulator
MIDM	Micro-Demodulator
OC	Output Combiner

Acronyms

OCA	Output Combiner- Active
RMDA	Rack Mounted Distribution Amplifier
SE	Stereo Encoder
SMI	Subscriber Module Interdiction
TVCB	TV Channel Blocker
VMI	VideoMask Interdiction

Industry Standard Acronyms

A	Ampere
AM	Amplitude Modulation
AC	Alternating Current
AGC	Automatic Gain Control
ASI	Asynchronous Serial Interface
AT	Attenuator
AWG	American Wire Gauge
BER	Bit Error Rate
CATV	Community Antenna Television
CCTV	Closed-Circuit Television
CMTS	Cable Modem Termination System
CNR	Carrier to Noise Ratio
CSO	Composite Second Order
CTB	Composite Triple Beat
dB	Decibel
DBS	Direct Broadcast Satellite
DC	Direct Current
DOCSIS	Data Over Cable Service Interface Spec
EBS	Educational Broadband Service
EQ	Equalizer
FDM	Frequency Division Multiplexing

Acronyms

FM	Frequency Modulation (88-108 MHz band)
HE	Headend
HFC	Hybrid Fiber Coax
Hz	Hertz
IF	Intermediate Frequency
kHz	Kilohertz
LAN	Local Area Network
LED	Light Emitting Diode
LNB	Low Noise Block Converter
MDU	Multiple Dwelling Unit
MER	Modulation Error Ratio
MHz	Megahertz
mbps	Megabits Per Second
mW	Milliwatt
PSI	Pound Per Square Inch
QAM	Quadrature Amplitued Modulation
QPSK	Quadrature Phase Shift Key Modulation
RF	Radio Frequency
SNR	Signal to Noise Ratio
TDM	Time Division Multiplexing
UHF	Ultra High Frequencies TV Channels 14-69 (470-806 MHz)
V	Volt
W	Watt
WAN	Wide Area Network
VHF	Very High Frequencies TV Channels 2 thru 13 and FM (54-216 MHz)
VSB/AM	Vestigial Side Band/Amplitude Modulation
XMOD	Cross-Modulation

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